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Investigations into the Robustness of Sustainable Real Estate Premiums and Commercial Real Estate Econometrics

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INVESTIGATIONS INTO THE ROBUSTNESS OF SUSTAINABLE REAL ESTATE PREMIUMS AND COMMERCIAL REAL ESTATE ECONOMETRICS

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Dedication

This is dedicated to my wife, Dame, who gave my personal life meaning and encouraged me to find it professionally; without her support, caring and patience, this document and this journey would not have been possible. This is dedicated to my children, Torren and Calder, who give my life purpose. May they grow knowing that dedication and perseverance make any goal achievable. This is dedicated my parents, a never-ending source of strength and support. Their foundations enabled me to take the risks necessary to pursue dreams.

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ABSTRACT

INVESTIGATIONS INTO THE ROBUSTNESS OF SUSTAINABLE REAL ESTATE PREMIUMS AND COMMERCIAL REAL ESTATE ECONOMETRICS

SPENSER J. ROBINSON

This dissertation consists of three papers, all using CoStar Group, Inc. Commercial Real Estate (CRE) data. The first two papers explore Sustainable Real Estate (Energy STAR and LEED building) rental premiums. The third paper develops and tests a new method for the empirical testing of CRE. Paper number one, Managing Well by Managing Good, is the first paper to argue *against* the existence of sustainable real estate premiums. It demonstrates that some of the Sustainable Real Estate rent premiums previously shown in the literature are neither theoretically nor empirically supported. In addition to presenting theoretical arguments against the premiums, the dissertation shows that, when properly controlling for geography through fixed effects and accounting for potentially missing variables, Energy Star buildings and Dual Energy Star/LEED buildings show no empirical support for market rental premiums. It provides evidence that Energy Star certification may be a signal of superior management, rather than an independent premium. Through market by market analysis of green building effects, it shows that possible market premiums are highly localized, and not national phenomena. The second paper, Size Does Matter, is amongst the only papers to argue for value weighting real estate portfolio in regressions. It also demonstrates clear differences in the potential sustainability premiums across different size categories of buildings. It provides evidence that the premiums in the extant literature may have been driven by the smaller subset of buildings, and that larger buildings demonstrated neither rent nor sales premiums. This paper also proposes that value weighting real estate portfolio estimations provides important information as to the economic impact of CRE building attributes in the hedonic regressions. The third paper, A New Paradigm, defines a new econometric method for assessing

normal and abnormal returns for CRE. The matching method uses appraisal based grid comparisons coupled with hedonic coefficient adjustments. This method was systematized and automated using the CoStar database. The matching method permits local comparisons of real estate assets rather than imposing national supply and demand parameters through hedonic regression. The theoretical development and empirical testing of these methods represents a new contribution in the commercial real estate literature.

Table of Contents

Contents

Introduction

This dissertation is comprised of three essays. Each essay uses CoStar data. The genesis of the idea was an investigation into the existence of Sustainable Real Estate premiums. The prior literature's' findings lacked theoretical foundations when compared with the author's personal experience in the commercial real estate (CRE) industry. This dissertation strives to accomplish three major goals, split into three distinct papers.

The first paper, Managing Well by Managing Good, outlines the theoretical arguments against sustainability premiums in CRE. The second paper, Size Does Matter, explores the effect of building size on sustainable real estate premiums in CRE. The third paper, A New Paradigm, presents a new theoretical model for examining CRE, and identifying expected returns.

Managing Well by Managing Good first outlines the burgeoning field of sustainable real estate in both academia and industry. Sustainable Real Estate typically describes buildings with an Energy Star (ESTAR), LEED, or both designations (Dual). The paper provides detailed explanations of these terms.

Several articles provided empirical support for sustainable building sales, leasing and cap rate premium. Perhaps the most cited is "Doing Well by Doing Good" by Eichholtz, Kok, and Quigley (2010). Other notable examples include Fuerst and McAllister (2011); Pivo and Fisher (2010); Wiley, Benefield, and Johnson (2010) all of whom found support for market premiums.

However, I question both the theoretical basis for Energy Star premiums, and the method used in the extant literature. Theoretically, Energy Star buildings offer little basis for rental premiums. Due to prevalent lease structure, potential costs savings do not get passed to tenant, thus, Energy Star buildings should rent at market levels.

The uniform use of Ordinary Least Squares hedonic regression in the extant literature presents an econometric concern. Market controls consisted primarily of linear adjustments in the form of dummy variables, and none tested for, or implemented controls for potential endogeneity.

This paper demonstrated that using clustered fixed effects to control for geography, rather than Ordinary Least Squares Dummy Variables (OLSDV) provided more consistent estimators of sustainable real estate effects. In addition it offered theoretical arguments that Energy Star certification may indicate management, rather than market premiums. Consequently, the models used in the extant literature likely suffered from a missing variable issue. This paper explored the idea that a real estate portfolio should be examined from both an equal weight and a value weight perspective, offering evidence that value weighting changes results in real estate portfolio valuation.

Size Does Matter explores the effect of building size and sale price on sustainable real estate premiums. Most of the prior literature examined sustainable real estate as a uniform body; this research showed that premiums, or the lack thereof, vary with different size categories of buildings. This paper also complements the first in providing additional evidence of a heterogenous relationship between size and sales/rent.

Both econometric and economic issues exist when evaluating a diverse set of buildings. From an econometric perspective, sales per square foot (PSF) varies with size. In general, larger buildings tend to sell at larger nominal prices, but lower PSF prices than smaller buildings. The assumption of independence for the independent variables used in most sales regressions, PSF or sale price, may be erroneous.

Economically, the issue of equal weight versus value weight in a real estate portfolio has received little academic attention. Although the bulk of the extant finance literature in stocks, bonds, etc., addresses both equal and value weights. The issues remains unexplored, at least in sustainable real estate. Value weighting matters at its most basic level because an investor can not easily purchase one floor of a twenty story buildings as an equal investment to a smaller building.

The findings set a precedent that future research should consider equal weight and value weight analyses.

A New Paradigm introduced, developed and tested a new econometric method for assessing Commercial Real Estate (CRE) normal and abnormal returns. It provides an objective, repeatable methodology suitable for academic use. After outlining the theoretical model, results from nearly 20 Million iterations of empirical tests of the model are presented.

The model is based primarily on the grid method used in traditional appraisals, but also incorporates the best elements of hedonic regression.

The empirical testing of the theoretical model show that the model works remarkable well in practice. It could potentially provide a new empirical method for testing commercial real estate.

ESSAY 1

Managing Well by Managing Good

The true story of sustainable real estate market premiums

Abstract This paper was the first to demonstrate that some of the Sustainable Real Estate rent premiums previously shown in the literature were neither theoretically or empirically supported. The first theoretical arguments against Energy Star building premiums were outlined and presented. When properly controlling for geography through fixed effects and accounting for potentially missing variables, Energy Star buildings and Dual Energy Star/LEED buildings showed no empirical support for market rental premiums; although, some support was found for LEED building rental premiums. It provided evidence that Energy Star certification may be a signal of superior management, rather than an independent premium. In addition, this paper was the first to present a market by market analysis of green building effects, and showed that possible market premiums were highly localized, and not a national phenomena.

1. Introduction

Academia has recently focused significant attention on the burgeoning field of Sustainable Real Estate. In addition to several articles in prominent journals, new journals such as the Journal of Sustainable Real Estate are now wholly dedicated to the topic. Sustainable Real Estate typically describes buildings with an Energy Star (ESTAR), LEED, or both designations (Dual).[1]. Trends in commercial real estate have driven increased attention of academic researchers; LEED-certified buildings now account for nearly one-third of new construction in the U.S. (Kok, McGraw, and Quigley, 2011)

Several articles provided empirical support for sustainable building sales, leasing and cap rate premium. Perhaps the most cited is "Doing Well by Doing Good" by Eichholtz, Kok, and Quigley (2010)[2]. Other notable examples include Fuerst and McAllister (2011); Pivo and Fisher (2010); Wiley, Benefield, and Johnson (2010) all of whom found support for market premiums.

However, I question both the theoretical basis for Energy Star premiums, and the method used in the extant literature. Theoretically, Energy Star buildings offer little basis for rental premiums. As discussed in more detail later in the paper, no meaningful supply constraints exist, potential costs savings do not get passed to tenants, and no demand enhancements appear in the market. Theoretically, Energy Star buildings should rent at market levels.

Empirically, all of the aforementioned articles used some form of Ordinary Least Squares hedonic regression. Market controls consisted primarily of linear adjustments in the form of dummy variables, and none tested for, or implemented controls for potential endogeneity.

This article demonstrated that using clustered fixed effects to control for geography, rather than Ordinary Least Squares Dummy Variables (OLSDV) provided more consistent estimators of sustainable real estate effects. I also offered theoretical

[1] See section 5 for detailed descriptions of Energy Star and LEED

[2] And the paper who's title I have respectfully adapted to this one.

arguments that Energy Star certification may be a signal of effective management, and provided evidence that the market premium achieved by Energy Star buildings may be more aptly attributed to the effective management of the property than the green designation. Consequently, the models used in the extant literature likely suffered from a missing variable issue. This paper explored the idea that a real estate portfolio should be examined from both an equal weight and a value weight perspective, offering evidence that value weighting changes results in real estate portfolio valuation.

Although the evidence presented in this paper suggested that green building market premiums may not exist, the author supports the many non-financial benefits of green buildings. In fact, when considering the many potential benefits associated with reduced pollution, increased productivity or Corporate Social Responsibility (CSR) policy compliance tenants may well prefer green buildings. All else equal–including rent–tenants may choose green buildings over traditional ones.

This article does argue any premiums should be driven by basic supply and demand metrics. At this point, the data suggests that tenants are not willing to *overpay* for green buildings.

The remainder of the paper is organized as follows. Section 2 reviews the literature. Section 3 outlines potential gaps in the existing literature. Section 4 details theoretical arguments regarding sustainable real estate premiums. Section 5 describes the data. Section 6 details the models and the empirical findings for the rent and sales data. Section 7 presents results for robustness tests. Section 8 concludes.

2. Literature Review

A significant body of work has been published on modeling rental and leasing premiums using the CoStar database and also using the NCREIF index.

Eichholtz et al. (2010) used hedonic regression modeling with a standard vector of controls. They found ESTAR rental premiums of 3.5% to 9%, and sales premiums of 26% on ESTAR; surprisingly, they found no LEED premiums. They used a sample of 199 sales from 2004 to 2007 as identified in the CoStar database for transactions. It appeared that they used 2006 rental data, but it is unclear. In addition to a standard vector of controls, they controlled for local demand with a NNN lease dummy and employment growth factors. To capture regionality, they included 694 “clusters” of control buildings in a 0.2 mile radius.

Some concerns with their paper are, as pointed out by Fuerst and McAllister (2011), the use a 0.2 mile cluster method and 694 dummies may have created improper pairings, and biased the results. For example, in Cleveland, 0.2 miles might reasonably select comparable buildings. However, in San Francisco 0.2 miles could transition from the affluent financial district to distinctly less desirable districts. Thus, the clustering by distance may not have created effective controls.

Their results included two curious findings. First their results showed that Energy Star, an easier designation to achieve, held a greater premium than LEED. This suggested that the many hurdles, consultants, and design requirements of LEED did not provide economic benefit, which was contrary to the prevailing sentiment in the real estate community and to the other empirical findings. Second they found that larger buildings, i.e. more stories, commanded lower rent, which is contrary to prior literature, e.g. (Shilton and Zaccaria, 1994)

Fuerst and McAllister (2011) used a hedonic regression based on CoStar data with transaction prices from 1999 to 2009, and rental rates as of Q4 2008. They found ESTAR and LEED rental premiums of 4% and 5% respectively and sales premiums of 25% and 26% respectively. In addition to the standard vector of controls, they include submarket, latitude and longitude dummies. They also include dummy variables for net lease and full service lease. Furthermore, they control for market conditions in their sales model by using the quarterly return for an MSA from the NAREIT index.

In their rent model they used 853 submarkets as controls. While this should further refine the hedonic model, it could open their regressions up to the incidental parameter problem(Baltagi and Kao, 2001), which suggests that a large number dummy variables could lead to inconsistent estimators.

Wiley et al. (2010) estimated a two-stage hedonic regression, with market dummies as their instrumental variables, simultaneously estimating rental rates and occupancy rates. They found ESTAR and LEED rental premiums of 8% and 17% respectively and sales premiums of $30 Per Square Foot (PSF) and $129 PSF respectively. The outer ranges of their findings seemed to indicate strong arbitrage opportunities; basic financial arbitrage theory would suggest that those premiums would be short-lived at best. In addition, their sales regression used nominal sales price as the dependent variable. This introduced heteroscedasticity due to the wide range of prices. Also, their premium findings were based on the interaction terms of Energy Star*Building square feet and LEED * Building square feet, but they ignored negative $7.5MM and $10.5MM coefficients on the stand alone LEED and Energy Star variables, which could have significantly offset their conclusions of a premium.

Pivo and Fisher (2010) examined what they defined as Responsible Property Investing (RPI) properties. The authors included in their definition of RPI properties that included Energy Star (not LEED), those close to transit stations, and those in urban revitalization areas. They used the National Council of Real Estate Investment Fiduciaries (NCREIF) database from 1999-2008, for a sample of 1,199 properties. They identified Energy Star with US EPA Energy Star labeling.

They estimated a hedonic regression for their data analysis. Since NCREIF uses appraised values, which are usually updated annually, the authors accounted for potential lag in appraised value by using a four quarter moving average of returns as the dependent variable. They found Energy Star properties' Net Operation Income (NOI) was 2.7% higher and that Energy Star buildings have 8.5% higher market values per square foot. Furthermore, they were able to identify a cap rate premium for Energy Star labeled properties of 0.5%.

Miller, Spivey, and Florance (2008) estimated the effect of sustainability on sales prices. They found sales premiums of 11% and 6% for ESTAR and LEED respectively. However, they use a limited data set, confining their study to Class A, five story or greater, 200,000 square foot plus, multi-tenant office properties built after 1970. They tested 643 sustainable buildings utilizing a hedonic regression model and found a 9.94% price premium for LEED buildings and a 5.76% price premium for Energy Star buildings.

The findings of specific sales and rental premiums were summarized in Table 1. In summary the literature has consistently found evidence of a rental and sales premium for LEED and Energy Star buildings. However, the data sets have been confined to a limited time period, which coincided with significant real estate growth. Some potential concerns, are the exclusive use of Ordinary Least Squares Dummy Variable (OLSDV) regression, that the results vary, some of the results were contrary to previous literature, and some did not seem economically realistic

Table 1: Summary of Existing Property Level Findings

			Rental Premium		Sales Premium	
Author	Database	Method	LEED	Energy Star	LEED	Energy Star
(Fuerst and McAllister, 2011)	CoStar	Hed. Reg.	5%	4%	25%	26%
(Eichholtz et al., 2010)	CoStar	Hed. Reg.	Not Sig	3.5%/9%	Not Sig	19%
(Wiley et al., 2010)	CoStar	Hed. Reg.	15%-17%	7%-8%	$129 PSF	$30 PSF
(Pivo and Fisher, 2010)	NCREIF	Hed. Reg.		2.7% (NOI)		8.5%
(Miller et al., 2008)	CoStar	Hed. Reg.			6%	11%

3. Sustainable Real Estate Literature Contributions

Several holes existed in the current literature on green real estate. From a research methods perspective, there are several unique aspects this paper investigated:

1. Examination of, and control for issues of endogeneity,
2. Investigation of fixed effect vs OLS Dummy Variable regressions
3. Investigation of equal weighting vs value weighting,

Issues of Endogeneity

Amongst the significant contributions to the literature this paper makes is the introduction of Professional Ownership related variables to help control for endogeneity. While the existing models attempted to control for the age of buildings, size and other physical characteristics, they may have failed to fully capture the issue of why certain buildings command rent premiums.

Specifically in green real estate, does eco-labeling itself create a premium, or do developers/managers of newer, well located buildings, that would tend to capture ceterus paribus rent premiums, enhance their offerings with LEED or Energy Star certifications? Previous research assumed the independence of the "green dummy" terms in the regressions. However, the models could suffer from either a missing variable or endogeneity problem

Prior literature has demonstrated that Real Estate Investment Trust (REIT) owned properties generate higher effective rents than non-REIT owned properties (Hardin III, Hill, and Hopper, 2009). The assertion that private professional managers might also outperform non-professional owners reasonably follows from those findings, although no study that I am aware of prior to this one documents that phenomenon. The first link to sales or rent and Energy Star could be the manager's negotiating ability and/or ability to maintain the property in a more attractive way than competitors.

In addition, sellers with stronger negotiating power tend to command higher sales prices (Fisher, Gatzlaff, Geltner, and Haurin, 2003). Managers demonstrating skill in maintaining energy costs in the upper quartile could represent a group of managers better and more skilled property management overall. The well documented effect of "Curb Appeal," or the appearance of a property's ability to affect price (Seiler, Lane, Seiler, and Harrison, 2010), could represent another correlation between price and effective management.

Energy consumption represents 30 percent of a typical commercial office buildings operating costs (EPA, 2006); effective management of this expense through attention to detail and utilization of technology could significantly reduce overall expenses. Thus, another possible link to sales price could be through increased NOI via lower costs, which would yield a higher sales price in traditional cap rate based sales.

Also, as discussed in more detail later, a current mismatch of financial motivation exists in lease structure. If tenants pay higher rent, one would expect they would benefit in the form of reduced operating expenses. However, 61% of the ESTAR buildings have Full Service Gross leases, where the tenant pays no operating expenses.

4. Theoretical Arguments Regarding Sustainability Premiums

The extant literature proposed several theoretical reasons for green building premiums. Arguments such as as improved productivity (Miller, Pogue, Gough, and Davis, 2009), using potentially positive externalities of green buildings to offset industry or firm negative externalities (Kok et al., 2011), or compliance with CSR policies all potentially could shift demand upwards. (Simons, Choi, and Simons, 2009) discussed the effect of legislative initiatives on increasing demand. The majority of their arguments, at their core, argued in some fashion simply that demand for green buildings exceeded supply. However, upon close examination of all the facts, the logic behind demand exceeding supply for all green buildings breaks down. In fact, simple demand and supply theory suggests that Energy Star buildings ***should not*** yield a market premium and that LEED/Dual buildings should.

As an editorial note, this author believes in the indisputable benefits of green buildings. As one of the worlds' largest energy consumers, 30% by some estimates, more ecological construction and management of buildings clearly provides global benefits. However, the focus of this paper was not whether green buildings provide any benefits, but rather whether consumers were willing to pay premiums for those benefits. Consumer preferences, and the conditional valuation of those preference may not always be in perfect alignment.

Energy Star–and the Energy Star Premium Puzzle

Energy Star (ESTAR) operates as a quartile ranking. Buildings ranking in the top quartile of energy usage compared to their peers, after controlling for age, size, climate, etc., earn Energy Star rankings. Several cities, such as New York City have recently passed legislation requiring Energy Star participation. Local Law 86 requires all buildings greater than 10,000 SF to participate in the system.[3] Any building owner may participate in the Energy Star program. As a peer evaluation program, the evaluation metrics are relative to other buildings rather than pre-defined. Almost by definition, there are few supply constraints.

[3] http://www.nyc.gov/html/planyc2030/downloads/pdf/ll84of2009_benchmarking.pdf

Without a strong likelihood of supply curve shifts, let us examine potential demand shifts. Assuming that ESTAR buildings provide decreased operations costs,[4] who would benefit from those savings–the owner or the tenant?

Commercial lease types range from Full Service Gross (FSG) to Triple Net (NNN), with a spectrum of leases between the two extremes. In an FSG lease, the tenant pays a fixed rent and the building owner incurs all operating costs. In a NNN lease the tenant pays both a fixed rent, and the tenant incurs all operating costs of the building. Leases not categorized as specifically FSG or NNN were categorized as Other; they may include a wide spectrum of lease types that distribute the risks and costs of buildings expenses between the owner and the tenant. The majority of office buildings, as shown in Table 2, tend to be FSG; the subject sample has about 41% pure FSG and 20% pure NNN for Non-Eco buildings. However, the Eco-Building sample demonstrated a heavy skew of 57% FSG lease types compared to only 17% NNN lease types. The remaining buildings were lease types somewhere in the middle of the two extremes.

Table 2: Rental Data by Lease Type

	FSG	NNN	Other
Non-Eco Buildings	41%	20%	39%
Eco-Buildings	57%	17%	36%
ESTAR Certified	61%	14%	25%
LEED Certified	42%	29%	29%
Dual Certified	50%	26%	24%

With a FSG lease, what motivation does a tenant have to pay additional rent for an Energy Star building? Additional energy savings benefit the building owner, not the tenant. In competitive equilibrium, I might expect ESTAR buildings to demonstrate slightly lower rent and capture a higher market share.

I find it hard to envision a commercial broker urging their client to choose an

[4] The literature on whether cost savings are in fact generated by green buildings is mixed. See (Ciochetti and McGowan, 2010; Galuppo and Tu, 2010; Miller, Pogue, Saville, and Tu, 2010; Newsham, Mancini, and Birt, 2009; Scofield, 2009)

Energy Star building, all else equal, because, “Even though it costs your company more rent, you’ll be saving the building owner energy costs!”

With no evident supply constraints and no excess demand drivers, no monetary theoretical basis for ESTAR premiums exists. Yet, the extant literature has demonstrated ESTAR premiums. I call this the Energy Star premium puzzle.

LEED and Dual

LEED certification has existed for just over a decade, and buildings must pass rigorous testing and undergo expensive assessments to achieve LEED certification. Clear supply constraints exist as the market provides a limited and finite supply of LEED buildings

At the same time, numerous federal and state regulations have required government tenants to occupy LEED certified buildings–see Table B in the Appendix for a partial list. In addition to government enhanced demand, informal conversations with high level market practitioners indicate that LEED buildings wield a certain cache to owners and tenants.

Limited supply and enhanced demand should create a market premium. Theoretically, LEED and Dual LEED/Energy Star certified building premiums are justified.

Fixed Effect vs OLS Dummy Variable

All the published articles used some sort of ordinary least squares Dummy Variable control as their method to control for geography. However, LEED buildings are neither randomly nor uniformly distributed. Certain states, like California, Texas, Minnesota, and Washington have significantly higher percentages of their total base as energy efficient. The use of dummy variables adjusts the intercept of rent or sales in a linear fashion. Unfortunately, the use so many dummy variable in a regression may create the ”incidental parameter problem,” causing the coefficients to become inefficient and unreliable (Baltagi and Kao, 2001). Fixed effect clustering controls for the many markets or submarkets without the use of market based dummy variables. Each of the variables are reduced by the mean of their submarket, and weighted within their cluster. This reduces heterogeneity, effectively controls for submarkets, and eliminates the incidental parameter problem. The fixed effect method is commonly used in the finance literature.

Equal Weight vs Value Weight

All of the current published research on sustainability premiums treats the portfolio of green real estate effectively as an equal weight portfolio. In other words, each observation represents an equal weight in the regressions. Both economic and econometric issues arise from the exclusive use of equal weighting.

In an economic sense, real estate assets are investment assets like any other financial investment. An investor attempts to generate returns whether they purchase stocks, bonds, or real estate assets. The predominant research method in the extant investment literature for stock and bond portfolios involves examining both an equal weight and a value weighted portfolio. That equal-weight returns produce different results than value-weight returns has been well documented in the financial investment literature (Brown and Warner, 1980; Fama, 1998; Fama and French, 1988). Real estate assets should be treated no differently.

In real estate, the practice of giving every observation equal weight suggests that an investor would generate the same effective return by purchasing five $200,000 real estate assets as they would by purchasing one $1,000,000 real estate asset. This may or may not be the case. Furthermore, an investor with only $200,000 can not effectively purchase a portion of the $1,000,000 asset.[5]

For the sales data, I used the natural log of sales as the weight. Since the rental data set did not include price, I selected size as the weighting variable for rent. Although not a perfect proxy for price due to the non-linear relationship between size and price, it acted as a reasonable proxy for value weighting the portfolio. This

[5]The author recognizes that the existence of Tenant-in-Common (TIC), and Real Estate Investment Trusts (REIT) do permit some buyers to purchase limited shares of real estate assets. However, REITs provide indirect ownership of real estate through equity holdings, while the direct investment in real estate assets is managed through fiduciary responsibility obligations as individual investments in the portfolio. Tenant-In-Common Association (TICA) recently changed their name to Real Estate Investment Securities Association (REISA), and there currently exists debate whether TICs are direct or indirect real estate investment. Furthermore, TIC investments represent a comparatively small portion of the market.

more heavily weights the larger, and more costly assets in the regression, in a similar manner to how they would be weighted in an economic investment portfolio.

Also, from an econometric perspective, the existing literature appeared to overlook the size of buildings as an issue other than as a control variable. Sustainable buildings tend to be larger than average size buildings. The subject rent sample contains all buildings in a market greater than 10,000 Square Feet (SF). The Eco building population had a mean size of 264,398 SF and standard deviation of 276,175 SF, compared to a mean of 56,239 SF and standard deviation of 88,819 SF for the non-green sample. The sales sample showed a similar discrepancy with means of 55,071 SF and 320,323 SF for the general population and Eco buildings, and standard deviations of 107,156 SF and 314,712 SF respectively.

Expected Signs

I expected the bulk of the standard control variables' sign and significance to align with those of previous authors, and little discussion was required. However, two distinguishing feature of this research were my expected signs for Energy Star, and the inclusion of Professional Management Variables. For a detailed explanation of the professional management variable, please see Section 5. As such, I confined the discussion to the sustainable real estate and professional management related variables.

Expected signs are listed in Table 3.

ESTAR: Although prior authors found the ESTAR variable statistically significant, I found no economic basis for this conclusion. Energy Star is a quartile ranking, and almost by definition has no supply side constraint.

As shown in Table 2, 61% of ESTAR office leases were Full Service Gross lease, where the tenant pays a flat rent and the owner pays the expenses. In this form of lease, the tenant receives no direct fiscal benefit for any energy savings. Since the tenant receives no fiscal benefit for the energy savings, what motivation do they have to pay more?

The only plausible explanation is the Energy Star buildings possess some sort of

Table 3: Expected Signs of Variables

Variable	Rent: Expected Sign	Rent: Previous Green Research Sign	Sales: Expected Sign	Sales: Previous Green Research Sign
ESTAR	Neutral	+	Neutral	+
LEED	+	+	+	+
Dual	+	+	+	+
Prof Owner	+	n/a	n/a	n/a
Prof Seller	n/a	n/a	+	n/a
Prof Buyer	n/a	n/a	-	n/a
Lnsize	-	-	-	-
Age100	-	-	-	-
Age75	-	-	-	-
Age50	-	-	-	-
Age40	-	-	-	-
Age30	-	-	-	-
Age20	-	-	-	-
Age15	-	-	-	-
Age10	-	-	-	-
Age5	-	-	-	-
Renovated	+	+	+	+
Percent Leased	+	+	+	+
Stories	+	+/-	+	+/-
A Class	+	+	+	+
B Class	+	+	+	+
NNN	-	-	-	-
FSG	+	+	+	+
Amenity	+	+	+	+

cache in the industry for which tenants are willing to pay.

As a former practitioner, it was not one of the author's personal experience that tenants would be willing to pay more for an equivalent space solely for the privilege of residing in an Energy Star building. As discussed earlier, I find it hard to envision a commercial broker urging their client to choose an Energy Star building, all else equal, because, "Even though it costs your company more rent, you'll be saving the building owner energy costs!"

My prediction for the sign of Energy Star for rent was neutral.

For sales, a positive premium would be justified. Assuming equal rent, building owners should earn additional income via documented energy savings. An equal capitalization rate on slightly higher net operating income would generate higher sales price.

LEED: LEED designations have only existed since roughly the year 2000. The bulk of the government ordinances requiring green leases have focused on LEED buildings.

The combined facts of a smaller inventory from a shorter building cycle, coupled with government driven demand enhancement should create a premium. Less supply, more demand.

I predicted a positive sign for LEED for rent and sales.

DUAL: Similarly, DUAL designations contain the LEED designations.

As with LEED, I predicted a positive sign for rent and sales.

PROF Owner: Professional Owners should operate and lease their properties better than ordinary operators. For a complete discussion and definition of the variable, see the Professional Ownership Variables heading in Section 5.

I predicted a positive sign for professionally owned buildings.

Prof Seller: A Professional Seller should be able to market their property better than an ordinary seller. In addition, assuming they have captured higher rent, their capitalized value will be higher.

I predicted a higher sales value, or a positive sign.

Prof Buyer: Theoretically, a Professional Buyer should be a more capable negotiator than an ordinary seller. They should be able to purchase at a better than market rate.

I predicted a lower sales value, or a negative sign.

5. Data

The primary data sources for my analysis came from CoStar.[6] CoStar contains over 2.8 Million US Commercial properties, including sales and leasing information. Data includes, but is not limited to location, physical buildings characteristics, tenants, and lease details. My rent sample contained data from Q4 2011, and the sales data covered 2001 to 2011. A detailed list of variables used in this research can be found in the Appendix, Table Appendix A.

Energy Star for Buildings

The U.S. Environmental Protection Agency and the U.S. Department of Energy jointly manage the Energy Star program. Energy Star is available for 13 types of commercial buildings, including retail stores, hotels, schools, supermarkets and more. Nearly 9,000 buildings across the nation have earned the Energy Star for superior energy efficiency over the past decade and the numbers continue to climb daily. Energy Star buildings typically use 35 percent less energy and emit 35 percent less carbon dioxide into the atmosphere than average buildings (U.S. Environmental Protection Agency, 2009).

Under the program, the energy performance of a building is scored on a 1-100 scale; buildings scored 75 or above are recognized as Energy Star Certified Buildings. The numbers directly relate to percentage ratings. For example, a building that has a score of 80 means the building is in the top 20% of facilities in the country for energy performance. The score is calculated by estimating how much energy the building would use if it were the best- or worst-performing building of its type (along with levels in between) in terms of its size, location, and number of occupants. The

[6] Source: CoStar Group, Inc.

rating system then compares the actual energy data input to the internal database to determine where the building ranks relative to other similar buildings (Ciochetti and McGowan, 2010).

Leadership in Energy and Environmental Design (LEED)

The U.S. Green Building Council (USGBC) operates the Leadership in Energy and Environmental Design (LEED) Green Building Rating System as an independent third party. They are a non-profit organization with a stated mission, "To transform the way buildings and communities are designed, built and operated, enabling an environmentally and socially responsible, healthy, and prosperous environment that improves the quality of life."

LEED promotes a whole-building approach to sustainability by examining five categories of building performance:

1. sustainable site development,
2. water efficiency,
3. energy efficiency,
4. materials selection,
5. and indoor environmental quality (U.S. Green Building Council, 2009).

Building owners earn points in each of the five categories, with allocation of points between credits based on the potential environmental impacts and human benefits of each credit with respect to a set of impact categories. In addition, properties can earn credit for regionally specific innovations that may relate to climate, transportation, or other related issues. Depending on the number of total points earned, buildings can achieve LEED levels of certified, silver, gold or platinum.

The certified level indicates conformance with minimum requirements for LEED certification, and the platinum certification level indicates outstanding levels in virtually all categories.

Descriptive Statistics

The rent data was cleaned to include only data with a size and rent fields existing, and the sales data cleaned to only include data with sale price and size fields in place.

The data consists of 48,733 rent observations across the top 50 Metropolitan Statistical Areas (MSA) (56 defined markets) in the United States; all rent observations are from Q4 2011. The sales data covers from 2001 to 2011, also in the top 50 MSA's (56 defined markets) in the United States. The sales data has 26,261 observations.

Table 4 summarizes size and rent statistics for the rental data by eco-building type. Clear differences in the mean size and mean rent were observed between non-Eco and Eco-labeled buildings. Table 5 summarizes the sales data by green building type. As with rent, clear differences appeared in both Per Square Foot (PSF) sales price and size between non-Eco and Eco buildings.

Table 6 shows a detailed market by market breakdown by size and by rent for green building type. Again, clear differences were observed not only between green and non-green buildings, but also between markets. For example the mean rent in New York City was $50.63 for non-green buildings compared to median rent of $16.47. Table 7 shows market by market size and sales PSF for green building type. Again, clear differences across market and building type were evidenced. New York City's mean PSF sales was $419 versus a median of $70.

Additionally, concentrations of green buildings were observed in western urban cities, and in Washington DC specifically.

Several extremely small minimum PSF prices observed in the data were verified as reasonable. There are approximately 20 sales under $1.00 PSF. All but one occur during the financial crisis period, and several are noted as auction or distress sales, which is controlled for in several of the regression specifications. In addition, the use of winsorized data, where the top and bottom percentiles are replaced by the 99th and 1st, did not significantly alter the findings herein.

Table 4: The following table provides descriptive statistics for the rental data set. The rental data set was from Q4 2011, and including the all office buildings over 10,000 SF from the top 50 MSA by population. Source for this, and all rental tables: CoStar Group, Inc.

	Size					**Rent**			
	n	**mean**	**std**	**max**	**min**	**mean**	**std**	**max**	**min**
No Eco-Label	45,354	56,239	88,819	3,781,045	10,000	18.62	10.23	600	0.95
All Eco	3,379	264,398	276,175	4,000,000	10,000	25.48	12.73	253.55	5.46
ESTAR Certified	2,473	228,464	233,246	2,650,000	10,000	24.561	11.0093	250	5.46
LEED Certified	278	223,761	331,746	4,000,000	10,524	28.545	16.7803	253.55	6.48
Dual Certified	628	423,892	341,333	1,721,242	33,851	27.719	16.0813	250	8.5

Table 5: The following table provides descriptive statistics for the sales data set. The sales data set was from 2001 through 2011, and included all office buildings sales over 10,000 SF from the top 50 MSA by population. Source for this, and all sales tables: CoStar Group, Inc

The small minimum PSF prices were verified. There are approximately 20 sales under $1.00 PSF. All but one occur during the financial crisis period, and several are noted as auction or distress sales.

	PSF					Size			
eco	**n**	**mean**	**std**	**max**	**min**	**mean**	**std**	**max**	**min**
No Eco-Label	45,354	56,239	88,819	3,781,045	10,000	18.62	10.23	600	0.95
All Eco	3,379	264,398	276,175	4,000,000	10,000	25.48	12.73	253.55	5.46
ESTAR Certified	2,473	228,464	233,246	2,650,000	10,000	24.56	11.0093	250	5.46
LEED Certified	278	223,761	331,746	4,000,000	10,524	28.55	16.7803	253.55	6.48
Dual Certified	628	423,892	341,333	1,721,242	33,851	27.72	16.0813	250	8.50

Table 6: The following table provides descriptive statistics for the rental data set, segmented by market. The rental data set was from Q4 2011, and including the all office buildings over 10,000 SF from the top 50 MSA by population (56 markets).

	No Eco Certification			ESTAR labeled only			LEED certified Only			Dual Certified		
Market Name	**n**	**Mean Size**	**Mean Rent**	**n**	**Mean Size**	**Mean Rent**	**n**	**Mean Size**	**Mean Rent**	**n**	**Mean Size**	**Mean Rent**
Atlanta	1,581	56,211	15.40	112	249,478	20.76	7	463,860	25.12	42	405,839	21.66
Austin	511	51,587	17.31	31	144,174	18.56	6	102,072	16.33	12	255,291	22.44
Baltimore	770	49,515	18.50	3	319,000	22.55	10	117,145	25.58	2	87,816	21.75
Birmingham	300	51,733	15.66	4	184,953	21.86						
Boston	1,343	48,994	18.00	29	207,404	23.93	6	427,420	43.58	8	423,486	37.70
Buffalo/Niagara Falls	184	49,206	14.40	3	442,670	22.33				1	34,113	8.63
Charlotte	587	52,513	16.89	48	196,904	21.11	9	423,438	26.42	7	446,904	26.90
Chicago	2,392	64,344	16.77	145	351,964	18.92	6	968,801	25.72	63	703,520	21.95
Cincinnati/Dayton	619	51,668	12.53	15	297,185	13.68	6	178,578	18.39	2	395,608	13.29
Cleveland	634	57,304	14.25	12	412,804	18.97	4	407,114	17.09	2	914,787	21.75
Columbus	679	46,375	12.62	8	364,677	18.13				2	243,256	14.00
Dallas/Ft Worth	1,676	76,008	15.97	126	281,295	19.56	13	313,526	24.81	31	412,575	25.09
Denver	1,002	49,630	15.90	105	168,614	19.84	13	169,646	21.78	57	329,782	21.47
Detroit	1,267	55,908	15.12	32	284,722	19.85				1	170,363	20.40
East Bay/Oakland	609	42,208	20.63	47	195,597	26.55	5	133,195	27.37	15	254,381	26.19
Hampton Roads	413	40,887	16.04	14	138,841	19.95	2	186,616	24.25	1	75,000	17.70
Hartford	372	58,023	16.45	11	283,433	22.86	1	33,700	18.95			
Houston	1,148	72,954	16.99	122	280,988	19.68	8	280,822	21.88	45	661,655	22.12
Indianapolis	599	50,578	15.35	18	265,489	17.74	1	26,892	20.00	2	105,854	22.50
Inland Empire (California)	773	29,619	16.47	25	78,067	20.20	3	126,295	23.80			
Jacksonville (Florida)	387	47,814	15.47	8	280,154	19.03				2	384,173	18.39
Kansas City	784	55,551	16.19	14	229,601	18.73	3	65,470	23.33	3	158,601	20.67
Las Vegas	679	37,435	16.85	5	111,642	28.15	5	104,158	26.56			
Long Island (New York)	859	64,223	24.57	7	478,241	30.35	1	113,284	21.00			
Los Angeles	2,144	56,665	25.00	238	207,236	29.26	11	178,672	35.54	54	468,174	32.88
Louisville	318	52,823	13.40	12	179,936	17.66	1	19,500	17.00			
Marin/Sonoma	121	40,736	26.28	7	83,317	36.66						
Memphis	273	59,093	14.89	3	102,388	20.24	1	147,982	27.50			
Milwaukee/Madison	539	49,892	14.05	23	161,309	15.56	3	97,525	15.63	4	80,384	15.00
Minneapolis/St Paul	910	57,416	13.33	73	278,904	13.88	3	128,305	16.67	23	519,180	15.10
Nashville	419	54,187	16.65	19	210,894	21.30	5	247,321	26.05	5	139,339	22.81
New Orleans/Metairie/Kenner	233	66,821	15.59	9	629,176	18.32						
New York City	718	181,808	50.63	46	624,767	55.31	3	1,027,991	120.68	10	764,424	103.22
Northern New Jersey	1,690	52,884	19.53	30	216,758	25.10	2	111,064	22.79	1	421,317	30.00
Oklahoma City	268	62,886	14.08	1	195,702	14.00						
Orange (California)	1,247	38,095	20.24	143	147,127	24.14	5	34,542	24.36	20	211,061	23.08
Orlando	573	42,344	16.03	21	180,843	20.96	3	136,066	20.72	1	640,741	20.00
Philadelphia	1,595	63,191	18.15	54	289,533	22.85	6	131,395	27.49	6	697,347	27.31
Phoenix	1,375	47,226	17.30	74	143,613	21.71	8	163,398	22.54	14	316,046	24.90
Pittsburgh	557	72,024	15.79	8	92,981	21.33	2	128,000	19.75			
Portland	643	45,853	17.92	49	163,062	22.53	16	137,335	23.47	6	383,766	22.83
Providence	255	45,996	16.33	1	150,000	22.39				1	330,449	23.00
Raleigh/Durham	496	39,750	16.97	21	157,571	20.52	2	207,454	27.77			
Richmond VA	339	55,804	15.74	16	141,177	18.64						
Sacramento	788	39,020	18.29	67	96,486	23.32	4	42,883	29.48	17	212,447	25.37
Salt Lake City	411	51,854	15.61	10	150,086	21.56	1	426,657	31.00	1	255,255	26.14
San Antonio	413	50,698	16.67	28	178,431	22.33	1	200,000	20.24	2	296,138	23.75
San Diego	903	40,182	21.34	65	161,267	27.14	4	63,833	30.52	11	309,886	30.82
San Francisco	435	59,523	30.20	60	272,331	34.68	3	90,778	35.80	40	425,738	38.87
Seattle/Puget Sound	1,088	45,912	18.88	47	214,859	22.59	19	189,807	26.80	33	437,174	24.79
South Bay/San Jose	568	44,883	23.73	34	127,347	29.93	6	261,557	33.30	9	130,541	30.65
South Florida	1,815	50,340	19.12	99	156,992	20.47	10	227,138	27.54	21	297,250	28.87
St. Louis	865	53,983	16.22	11	461,004	22.01	4	124,750	22.00	1	123,055	24.00
Tampa/St Petersburg	730	42,252	15.45	32	236,518	23.58	2	223,500	27.00	5	408,778	25.69
Washington DC	2,149	74,422	25.46	219	236,453	38.87	43	198,709	38.22	44	303,627	41.67
Westchester/So Connecticut	308	65,730	23.99	9	284,644	29.82	1	288,322	35.00	1	384,000	36.66

Table 7: The following table provides descriptive statistics for the sales data set, segmented by market. The sales data set was from 2001 through 2011, and included all office buildings sales over 10,000 SF from the top 50 MSA by population (56 markets).

	Non-Eco Buildings			Energy Star Certified			LEED Certified			Dual Certified		
Market	**n**	**Mean Size**	**Mean Sales PSF**	**n**	**Mean Size**	**Mean Sales PSF**	**n**	**Mean Size**	**Mean Sales PSF**	**n**	**Mean Size**	**Mean Sales PSF**
Atlanta	910	56,547	113.34	33	313,007	183.33	1	30,000	55.42	18	549,021	196.98
Austin	208	43,849	88.64	8	188,971	247.35	2	155,929	301.03	3	404,208	271.00
Baltimore	436	46,341	99.43	5	342,470	204.42	3	104,531	179.59	1	81,728	1.85
Birmingham	73	53,602	89.93	1	205,000	18.29	1	587,528	289.35	-	-	.
Boston	973	60,235	138.55	30	237,297	233.50	13	330,586	266.80	5	797,065	373.27
Buffalo/Niagara Falls	59	61,496	39.25	1	1,200,000	70.85	1	430,458	196.30	-	-	.
Charlotte	180	56,925	115.11	9	281,556	186.34	2	189,340	162.93	1	866,810	177.55
Chicago	1,600	66,465	104.50	64	449,848	167.90	4	200,730	210.14	37	736,531	211.22
Cincinnati/Dayton	321	42,088	73.50	6	369,118	104.89	7	42,314	77.30	1	26,400	64.39
Cleveland	323	57,803	64.69	4	921,550	89.16	3	201,475	42.38	1	506,656	19.24
Columbus	411	47,348	80.31	2	461,829	89.11	-	-	.	1	161,598	114.79
Dallas/Ft Worth	661	84,318	94.19	42	255,006	122.82	6	214,862	132.39	8	441,496	147.39
Denver	715	46,098	106.02	52	215,001	163.95	8	94,552	181.47	26	326,226	199.92
Detroit	580	56,730	87.36	3	198,400	144.76	1	215,000	193.62	2	113,165	226.39
East Bay/Oakland	411	30,848	166.50	12	218,850	181.15	3	109,863	265.41	5	196,755	212.56
Hampton Roads	89	43,388	106.12	4	237,137	158.16	-	-	.	-	-	.
Hartford	94	63,928	78.17	2	545,617	71.35	-	-	.	-	-	.
Houston	509	76,885	90.42	43	334,001	124.45	-	-	.	21	557,453	192.29
Indianapolis	104	49,378	88.01	5	276,241	126.47	-	-	.	-	-	.
Inland Empire (California)	459	25,730	132.72	1	427,883	152.38	-	-	.	-	-	.
Jacksonville (Florida)	207	43,064	88.65	5	382,109	104.00	1	150,000	86.32	-	-	.
Kansas City	267	51,645	81.07	5	229,253	151.07	-	-	.	1	187,000	208.56
Las Vegas	402	30,423	192.22	-	-	.	-	-	.	1	11,785	70.00
Long Island (New York)	429	49,107	177.08	4	761,922	261.72	-	-	.	-	-	.
Los Angeles	1,602	44,316	167.93	79	276,955	239.99	9	177,984	291.68	19	499,333	260.14
Louisville	87	58,870	64.99	1	686,292	187.24	-	-	.	-	-	.
Marin/Sonoma	60	28,383	227.75	1	39,627	441.62	-	-	.	-	-	.
Memphis	75	48,388	79.58	-	-	.	-	-	.	-	-	.
Milwaukee/Madison	204	45,330	96.32	9	180,233	127.86	1	29,297	231.25	-	-	.
Minneapolis/St Paul	367	54,144	93.76	22	375,150	138.93	5	96,978	186.03	7	681,543	147.49
Nashville	127	53,280	98.19	1	538,788	129.92	2	124,869	121.07	1	498,961	139.79
New Orleans/Metairie/Kenner	51	87,488	64.63	2	1,016,606	85.76	-	-	.	-	-	.
New York City	790	193,153	435.19	43	743,214	407.88	6	1,066,066	459.62	12	1,109,145	439.46
Northern New Jersey	1,200	55,946	117.47	31	227,958	177.39	3	295,709	209.79	7	633,694	201.47
Oklahoma City	116	61,305	76.33	-	-	.	1	147,350	199.19	-	-	.
Orange (California)	658	36,074	168.84	27	174,869	262.15	1	40,058	195.03	9	241,637	270.31
Orlando	341	42,968	133.90	15	180,749	144.74	3	115,781	157.79	3	152,361	194.96
Philadelphia	1,037	58,883	102.27	22	418,042	151.45	3	526,961	226.73	4	600,254	113.97
Phoenix	983	41,295	145.59	34	200,471	206.45	2	80,505	173.76	7	359,301	329.37
Pittsburgh	215	58,564	64.69	2	868,913	136.90	1	30,000	83.33	-	-	.
Portland	382	36,479	128.23	12	248,275	204.74	9	83,530	140.94	3	418,955	163.42
Providence	75	55,588	84.60	-	-	.	1	29,256	136.38	-	-	.
Raleigh/Durham	136	34,521	109.75	3	369,352	197.48	1	31,725	56.74	-	-	.
Richmond VA	97	59,970	104.15	2	100,660	97.55	-	-	.	-	-	.
Sacramento	478	33,198	151.01	24	114,641	190.58	2	112,429	112.14	6	253,023	227.64
Salt Lake City	66	33,667	115.67	2	253,648	134.83	-	-	.	-	-	.
San Antonio	65	38,493	118.34	6	249,579	112.15	1	145,025	226.51	-	-	.
San Diego	552	36,809	188.44	30	180,247	279.52	5	88,030	256.14	6	348,941	317.27
San Francisco	339	52,957	243.25	40	240,178	314.19	4	107,644	258.73	17	402,280	406.86
Seattle/Puget Sound	699	38,253	170.70	14	233,306	295.35	11	238,723	296.33	8	299,600	307.89
South Bay/San Jose	280	33,824	248.15	7	168,995	351.75	4	47,999	593.82	1	142,651	219.42
South Florida	1,386	44,261	135.05	37	185,598	179.89	6	78,725	177.60	14	443,754	221.31
St. Louis	236	70,111	89.88	7	324,905	126.54	2	117,450	193.00	-	-	.
Tampa/St Petersburg	547	41,647	108.99	9	297,695	149.56	1	247,000	101.22	2	644,008	197.02
Washington DC	1,087	74,578	204.73	108	235,135	370.47	17	215,571	457.33	37	298,476	371.37
Westchester/So Connecticut	116	64,190	133.34	2	327,264	185.80	1	288,322	104.05	-	-	.

Professional Ownership Variables

To address potential issues of a missing variable problem, I created professional ownership dummy variable. This helped assess whether the developers and managers who own and operate these buildings exhibited superior site selection, construction or management, or if the presence of green certification in and of itself created a market premium.

Prof Owner: The Prof Owner, professional ownership variable, used in the rent regressions was a binary dummy variable equal to 1 when an ownership group, as listed by their address in CoStar,[7] owned 6 or more physical properties totaling greater than 500,000 SF. Thus a group that owned 10 small buildings would not qualify via the SF hurdle. Furthermore, a group that owned one or two large buildings would not qualify via the number of properties hurdle.

These measures were intended to capture ownership groups whose total holdings qualify them as professional owners. The number and scale of commercial property holdings would require, at a minimum, several full time staff members to effectively operate and manage. The dummy variable was set to zero otherwise. While some of the non-Prof Owners may in fact be better owner operators than some of the Prof Owners, the dummy variable's purpose was test for statistical significance of professional ownership at a macro level.

8,327 observations, owned by a total of 435 ownership groups qualified as professionally owned. Professionally owned buildings represented 17% of the building population.

However, professional owned buildings represented a considerably larger portion of green buildings. As shown in Table 8, 69% of Energy Star population, 36% of the LEED population, and 74% of the Dual population were professionally owned. Roughly 2/3 of the green population was professional owned, while only 13% of the non-eco population was.

Prof Seller: A Professional Seller variable was set to one when the seller of a

[7] 5,884 observations had no address field, and were set to zero

Table 8: This table shows nominal and percentage breakdowns by green building type for professionally and non-professionally owned buildings from the rental data set. Percentages indicate the percent of building type in terms of professional ownership, i.e Prof Owned ESTAR buildings/ Total ESTAR buildings.

	No Prof	%No Prof	Prof Owner	% Prof Owner	Total	% Total
ESTAR	758	30.7%	1,715	69.3%	2,473	5.1%
LEED	179	64.4%	99	35.6%	278	0.6%
Dual	163	26.0%	465	74.0%	628	1.3%
Green	1,100	32.6%	2,279	67.4%	3,379	6.9%
Non-Eco	39,309	86.7%	6,045	13.3%	45,354	93.1%
Population	40,409	82.9%	8,324	17.1%	48,733	100.0%

property correlated to the rent database as a Professional Owner. It was set to zero otherwise. One potential hazard with this method is that ownership groups who qualified as professional owners in Q4 2011, may or may not have qualified at the time of sale. The rent database covers only Q4 2011, while the sales data covers ten years. Additionally, some building owners who may have qualified as professional at the time of sale, might no longer be so in Q4 2011. However, I believe the noise around the estimate should be minimal.

Prof Buyer: A Professional Buyer variable was set to one when the seller of a property correlated to the rent database as a Professional Owner. It was set to zero otherwise. As with Professional Sellers, there may be some omitted or erroneously added observations due to time lag.

Prof Buyer: A Professional Buyer variable was set to one when both the buyer and seller were categorized as professional

As shown in Table 9, 97% of the traditional, or non-sustainable building sales did not involved a professional buyer or seller. However, 29% of the total green building sales did involve a professional buyer or seller.

Table 9: This table shows nominal and percentage breakdowns by green building type for professionally and non-professionally bought/sold buildings from the sales data set. Percentages indicate the percent of building type in terms of professional ownership, i.e Prof Sold ESTAR buildings/ Total ESTAR buildings

	No Prof	%No Prof	Prof Seller	%Prof Seller	Prof Buyer	%Prof Buyer	Prof Both	%Prof Both	Totals	%Total
ESTAR	663	71.1%	32	3.4%	212	22.7%	26	2.8%	933	3.6%
LEED	123	77.8%	13	8.2%	17	10.8%	5	3.2%	158	0.6%
Dual	203	68.8%	13	4.4%	75	25.4%	4	1.4%	295	1.1%
Green	989	71.4%	58	4.2%	304	21.9%	35	2.5%	1,386	5.3%
Non-Eco	24,070	96.8%	228	0.9%	545	2.2%	32	0.1%	24,875	94.7%
Population	25,059	95.4%	286	1.1%	849	3.2%	67	0.3%	26,261	100.0%

6. Model Description and Empirical Results

The OLSDV rent and sales models were of a standard one stage semi-log hedonic regression form (Rosen, 1974):

$$ln(R_{jt}) = \alpha_j + \beta_j X_i + \phi_j Z_i + \varepsilon_j \tag{1}$$

$$PSF_{jt} = \alpha_j + \beta_j X_i + \phi_j Z_i + \varepsilon_j \tag{2}$$

where:

ln (R_{jt})	= natural log of average rent per square foot in a given building j
(PSF_{jt})	= sales price per square foot in a given building j
X_i	= a vector of the property specific explanatory variables
β_i	= the regression-derived coefficient for property characteristic i
Z_i	=a vector of time and non-property variables
ϕ_i	= the regression-derived coefficient for time and non-property variable i
ε_j	= random error term
j, t	= property and time variables respectively

A detailed list of the variables used, along with their corresponding fields in the CoStar database can be found in the Appendix, Table A.

6.1. OLSDV Regression

Rent

Table 10 shows the rent results, from standard OLSDV regressions. Eight different regression configurations are shown. Models 1-4 include 1,284 submarket dummies; Models 2 and 4 add the professional ownership controls, and Models 3 and 4 are weighted by size. Models 5-6 include 55 market dummies, while Models 7-8 have no market controls; each set is shown without and with professional ownership controls respectively.

The findings from the OLSDV regressions without management controls were reasonably similar to the extant literature Eichholtz et al. (2010); Fuerst and McAllister (2011). The unweighted regressions in Models 1 and 5 found 1.7% and 2.8% market premiums for Energy Star at a 1% significance level. LEED buildings commanded 9.9% to 14.3% premiums, and Dual buildings generated 3.5% to 6.4% rent premiums, all at 1% significance.

However, the addition of the Prof Owner variable changed the scale of the ESTAR variables. Prof Mgmt was highly significant in all specifications. This indicated a clear connection between professional ownership and rent. The data suggested that ceterus paribus, a professional owner extracted from a 1.3% to a 2.1% market rent premium from their tenants.

Furthermore, the coefficients on Energy Star dropped approximately 20%, from 0.028 to 0.021, indicating a clear relationship between management and ESTAR. Interestingly, LEED and Dual building coefficients were largely unchanged. However, in the OLSDV regressions, even with the Prof Owner variable, all green building rent premiums continued to be significant at the 1% level.

The model appeared to be generally well behaved in that all control coefficients were of the proper sign and reasonable scale. Weighting the regressions, using size in the rent data, shown in Models 3 and 4, had very little effect in the OLSDV regressions.

Finally, I noted that the R-squared for Model 8, with the Prof Owner variable but no market controls was 0.2359. Thus, the higher R-squared in the other models could be largely attributed to the submarket or market dummies. I specifically mention this as the careful reader will observe that the R-squared of my fixed effects models in the next section were identical to the no market dummies model. This supported the argument that the fixed effect models have equivalent explanatory power to the OLSDV regressions, sans the submarket dummies.

Table 10: This table presented a series of regressions on lnrent. Models 1 and 2 included 1,284 submarket dummy variables. Models 3 and 4 also had 1,284 submarket dummy variables, and were both weighted by lnsize. Models 5 and 6 included 55 market dummies. Models 7 and 8 included no market or submarket controls. Models 2, 4, 6, and 8 all included the Prof Owner variable. Results were the regression coefficient(T-Value). ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

Variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**
ESTAR	0.017***	0.013**	0.017***	0.013**	0.028***	0.021***	0.038***	0.020**
	(2.945)	(2.124)	(3.074)	(2.227)	(4.320)	(3.133)	(4.783)	(2.466)
LEED	0.099***	0.098***	0.096***	0.096***	0.143***	0.141***	0.168***	0.164***
	(6.262)	(6.222)	(6.478)	(6.432)	(8.098)	(8.029)	(7.914)	(7.735)
Dual	0.035***	0.030***	0.038***	0.033***	0.064***	0.056***	0.031**	0.013
	(3.081)	(2.649)	(3.665)	(3.200)	(5.146)	(4.510)	(2.072)	(0.842)
Prof Owner		0.013***		0.013***		0.021***		0.051***
		(3.727)		(3.831)		(5.367)		(10.768)
Intercept	2.781***	2.852***	2.784***	2.855***	2.704***	2.734***	2.336***	2.388***
	(65.746)	(65.425)	(67.719)	(67.409)	(102.729)	(102.332)	(94.401)	(94.794)
lnsize	0.030***	0.028***	0.030***	0.029***	0.025***	0.023***	0.026***	0.021***
	(15.085)	(14.278)	(15.604)	(14.784)	(11.589)	(10.414)	(10.112)	(7.933)
age100	−0.166***	−0.167***	−0.170***	−0.171***	−0.093***	−0.093***	−0.015	−0.016
	(−20.228)	(−20.284)	(−20.821)	(−20.880)	(−11.272)	(−11.287)	(−1.582)	(−1.612)
age75	−0.176***	−0.176***	−0.179***	−0.179***	−0.130***	−0.130***	0.034***	0.033***
	(−23.648)	(−23.720)	(−24.319)	(−24.394)	(−16.863)	(−16.890)	(3.767)	(3.721)
age50	−0.194***	−0.194***	−0.195***	−0.196***	−0.131***	−0.131***	−0.040***	−0.041***
	(−26.866)	(−26.958)	(−27.039)	(−27.132)	(−16.832)	(−16.905)	(−4.343)	(−4.464)
age40	−0.177***	−0.178***	−0.181***	−0.181***	−0.130***	−0.131***	−0.058***	−0.060***
	(−28.355)	(−28.465)	(−28.935)	(−29.053)	(−19.338)	(−19.483)	(−7.186)	(−7.482)
age30	−0.174***	−0.175***	−0.177***	−0.178***	−0.160***	−0.161***	−0.120***	−0.123***
	(−34.016)	(−34.138)	(−34.474)	(−34.604)	(−29.034)	(−29.266)	(−18.244)	(−18.754)
age20	−0.153***	−0.154***	−0.155***	−0.156***	−0.152***	−0.154***	−0.109***	−0.114***
	(−33.379)	(−33.550)	(−33.841)	(−34.019)	(−30.877)	(−31.210)	(−18.482)	(−19.318)
age15	−0.087***	−0.088***	−0.089***	−0.090***	−0.087***	−0.089***	−0.085***	−0.090***
	(−11.220)	(−11.354)	(−11.624)	(−11.761)	(−10.162)	(−10.374)	(−8.250)	(−8.694)
age10	−0.084***	−0.085***	−0.087***	−0.088***	−0.084***	−0.086***	−0.108***	−0.113***
	(−14.763)	(−14.910)	(−15.291)	(−15.445)	(−13.446)	(−13.743)	(−14.467)	(−15.127)
age5	−0.027***	−0.027***	−0.030***	−0.030***	−0.027***	−0.028***	−0.034***	−0.036***
	(−5.075)	(−5.041)	(−5.583)	(−5.549)	(−4.587)	(−4.642)	(−4.788)	(−5.055)
Renovated	0.037***	0.037***	0.036***	0.036***	0.042***	0.043***	0.019***	0.020***
	(8.185)	(8.212)	(8.057)	(8.083)	(8.361)	(8.434)	(3.155)	(3.340)
Percent Leased	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.002***	0.002***
	(20.283)	(20.342)	(20.191)	(20.254)	(26.142)	(26.234)	(31.770)	(31.993)
stories	0.002***	0.002***	0.002***	0.002***	0.004***	0.005***	0.009***	0.009***
	(5.168)	(5.231)	(5.223)	(5.288)	(12.992)	(13.303)	(21.981)	(22.611)
A Class	0.233***	0.232***	0.234***	0.232***	0.278***	0.275***	0.314***	0.307***
	(43.289)	(42.894)	(44.363)	(43.965)	(47.372)	(46.718)	(45.055)	(43.888)
B Class	0.113***	0.113***	0.114***	0.114***	0.134***	0.133***	0.149***	0.148***
	(35.404)	(35.358)	(35.335)	(35.291)	(38.289)	(38.139)	(35.710)	(35.367)
NNN	−0.102***	−0.102***	−0.105***	−0.105***	−0.116***	−0.116***	−0.148***	−0.149***
	(−28.945)	(−28.935)	(−29.698)	(−29.688)	(−30.210)	(−30.231)	(−33.250)	(−33.363)
FSG	0.105***	0.106***	0.106***	0.106***	0.102***	0.102***	0.061***	0.060***
	(35.067)	(35.139)	(35.366)	(35.445)	(31.101)	(31.116)	(16.877)	(16.682)
Amenity	0.006**	0.005*	0.006**	0.006**	0.014***	0.014***	0.007*	0.006*
	(2.045)	(1.950)	(2.111)	(2.013)	(4.712)	(4.576)	(1.876)	(1.675)
R-Square	0.6089	0.6093	0.6202	0.6206	0.4795	0.4800	0.2341	0.2359
Model N	48,630	48,630	48,630	48,630	48,630	48,630		
Submarket Dummies	x	x	x	x				
Weighted			x	x				
Market Dummies					x	x		
No Market Controls							x	x

Sales

Sales results are shown in Table 11. Eight Models are shown. Model 1 begins with basic market dummies, Model 2 adds professional ownership controls, and Model 3 adds sale condition controls. Models 4-6 repeat the cycle, but weighted by Sale Price. Models 7 and 8 are shown for reference with submarket dummies and with no market controls.

For the sales models without ownership controls, the findings again mirrored the extant work with reasonable similarity Eichholtz et al. (2010); Fuerst and McAllister (2011). The unweighted regressions in Models 1 and 5 found $40 and $33 PSF market premiums for Energy Star at a 1% significance level. LEED buildings commanded $80 and $75 PSF premiums, and Dual buildings generated $71 and $65 PSF rent premiums, all at 1% significance. Using the mean PSF prices for ESTAR, LEED, and Dual of $257 PSF, $247 PSF and $223, the premiums were 12%, 30% and 29% respectively.

The Prof Buyer/Seller/Both variables were all highly significant in every specifications. This indicated a clear connection between professional ownership and sales. The Prof Seller variable aligned with my expectations with a $52 to $55 PSF premium range in the regressions. Surprisingly, the Prof Buyer variable indicates that Professional Buyers purchased their buildings at over market prices, and when both sides of the transaction included real estate professionals, the market premium jumped up even higher.[8] One would think the gains through professional purchases and seller should offset, but that is not the case.

The most plausible explanation for this finding is that professional owners tended to purchase premium or trophy buildings. The logistic regressions, discussed in section 6.3 support this theory in that Professionals are much more likely to purchase larger, A-Class buildings with amenities.

Comparing Model 1 with 4, and Model 2 with 5, the unweighted and weighted re-

[8]Similar findings in a related by paper on green building sales have been found by Fuerst, Gabrielli, and McCallister. Available at SSRN: http://ssrn.com/abstract=2114528 or http://dx.doi.org/10.2139/ssrn.2114528

gressions respectively, showed minimal effect. However, when I included a full suite of sale condition controls, weighting did effect the size of the green coefficients, although not their significance levels. I saw ESTAR and Dual premiums in particular drop by more than half. Thus with a full suite of condition controls, value weighting appears to impact at the least the scale of the market premiums, if not their significance.

Table 11: This table presented a series of OLSDV regressions on sales PSF. Models 1 through 6 included 55 market dummies. Models 4-6 were weighted by lnsales. Models 7 included submarket dummies and Model 8 included no market or submarket controls for reference. Models 2, 4, 6, 7 and 8 all included the Professional buyer and seller related variables. Models 3 and 6 included a full suite of sale condition controls as well. Results were the regression coefficient(T-Value).***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**
ESTAR	39.926***	33.964***	34.924***	39.010***	33.440***	19.369***	28.665***	24.297***
	(9.946)	(8.412)	(8.690)	(10.379)	(8.848)	(7.683)	(7.713)	(5.215)
LEED	80.075***	74.354***	75.268***	81.113***	75.089***	63.134***	56.018***	80.338***
	(9.059)	(8.427)	(8.577)	(9.571)	(8.877)	(10.102)	(6.926)	(7.870)
Dual	70.561***	66.009***	65.637***	69.089***	64.773***	33.595***	55.850***	34.812***
	(10.306)	(9.649)	(9.641)	(11.008)	(10.329)	(9.879)	(8.875)	(4.420)
Prof Buyer		37.976***	38.725***		35.246***	20.849***	25.730***	43.612***
		(9.423)	(9.653)		(9.240)	(7.770)	(6.941)	(9.372)
Prof Seller		52.143***	50.590***		53.369***	55.467***	37.456***	66.419***
		(7.973)	(7.776)		(8.526)	(11.709)	(6.225)	(8.790)
Prof Both		86.307***	89.081***		87.586***	126.110***	47.835***	85.224***
		(6.475)	(6.722)		(7.056)	(16.585)	(3.931)	(5.530)
Intercept	262.294***	278.184***	276.888***	259.017***	274.724***	180.621***	204.440***	325.852***
	(17.804)	(18.874)	(18.806)	(17.636)	(18.703)	(10.620)	(11.048)	(26.751)
lnsize	−18.410***	−19.770***	−19.539***	−17.204***	−18.534***	−0.604	−28.860***	−5.775***
	(−14.803)	(−15.887)	(−15.679)	(−14.073)	(−15.155)	(−0.495)	(−23.198)	(−4.085)
age100	5.238	5.576	4.689	3.056	3.460	−48.307***	−9.445**	31.361***
	(1.181)	(1.261)	(1.060)	(0.680)	(0.772)	(−8.280)	(−2.219)	(6.310)
age75	−15.130***	−14.648***	−15.282***	−17.708***	−17.179***	−77.179***	−20.620***	20.542***
	(−3.782)	(−3.674)	(−3.832)	(−4.381)	(−4.265)	(−15.539)	(−5.407)	(4.564)
age50	−8.641**	−8.855**	−8.963**	−11.101***	−11.304***	−63.142***	−22.442***	1.481
	(−2.246)	(−2.309)	(−2.339)	(−2.834)	(−2.896)	(−12.158)	(−6.147)	(0.338)
age40	−10.575***	−10.909***	−10.495***	−11.845***	−12.187***	−37.294***	−20.118***	−0.121
	(−2.897)	(−2.998)	(−2.883)	(−3.194)	(−3.298)	(−7.759)	(−5.809)	(−0.029)
age30	−8.221**	−8.447**	−7.718**	−9.654***	−9.875***	−48.497***	−14.778***	0.660
	(−2.480)	(−2.557)	(−2.330)	(−2.867)	(−2.943)	(−10.928)	(−4.688)	(0.175)
age20	−3.232	−3.995	−3.804	−4.854	−5.642*	−43.576***	−6.692**	7.276**
	(−1.030)	(−1.277)	(−1.211)	(−1.525)	(−1.778)	(−10.385)	(−2.247)	(2.036)
age15	21.022***	20.623***	18.865***	19.994***	19.570***	−21.951***	17.583***	28.564***
	(4.480)	(4.410)	(4.038)	(4.220)	(4.145)	(−3.901)	(4.035)	(5.295)
age10	33.931***	33.689***	31.889***	32.990***	32.735***	2.249	30.963***	41.929***
	(8.691)	(8.657)	(8.196)	(8.367)	(8.331)	(0.443)	(8.434)	(9.438)
age5	36.551***	36.604***	35.024***	36.775***	36.871***	30.213***	35.830***	45.841***
	(9.665)	(9.711)	(9.306)	(9.612)	(9.671)	(6.198)	(10.088)	(10.629)
stories	1.202***	1.134***	1.260***	1.166***	1.101***	0.670***	0.727***	2.357***
	(6.297)	(5.958)	(6.632)	(6.609)	(6.263)	(7.100)	(3.840)	(11.031)
A Class	73.141***	70.514***	70.578***	72.393***	69.907***	59.913***	52.602***	73.682***
Weighted				x	x	x		
Market Dummies	x	x	x	x	x	x		
Sale Condition Controls			x			x		
Submarket Dummies							x	

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variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**
	(23.054)	(22.249)	(22.358)	(23.392)	(22.620)	(17.866)	(17.631)	(20.377)
B Class	24.139***	24.095***	24.065***	23.996***	23.952***	17.523***	14.166***	26.640***
	(14.638)	(14.660)	(14.707)	(14.240)	(14.264)	(6.732)	(9.231)	(14.146)
lnland	−0.869	−0.680	−1.164	−1.644**	−1.439*	−9.354***	14.250***	−18.847***
	(−1.058)	(−0.831)	(−1.427)	(−2.005)	(−1.760)	(−11.134)	(15.914)	(−20.789)
Amenity	9.222***	8.661***	9.000***	10.249***	9.644***	31.772***	6.966***	6.014***
	(6.137)	(5.780)	(6.034)	(6.722)	(6.344)	(15.135)	(4.977)	(3.573)
Year 2002	1.609	1.388	0.982	1.357	1.108	−6.195	4.794	7.135*
	(0.439)	(0.380)	(0.270)	(0.367)	(0.300)	(−1.334)	(1.436)	(1.688)
Year 2003	1.850	1.754	2.012	1.395	1.318	−7.255*	5.470*	4.313
	(0.515)	(0.490)	(0.565)	(0.385)	(0.365)	(−1.658)	(1.673)	(1.044)
Year 2004	6.623*	6.530*	7.188**	5.697*	5.607	−6.107	11.459***	10.799***
	(1.942)	(1.921)	(2.126)	(1.657)	(1.636)	(−1.459)	(3.685)	(2.752)
Year 2005	23.481***	22.925***	23.761***	22.478***	21.875***	11.674***	27.286***	25.507***
	(7.201)	(7.052)	(7.340)	(6.845)	(6.684)	(2.932)	(9.183)	(6.792)
Year 2006	45.465***	44.997***	45.878***	44.748***	44.256***	38.631***	49.516***	48.422***
	(13.972)	(13.873)	(14.187)	(13.689)	(13.584)	(9.946)	(16.667)	(12.941)
Year 2007	60.388***	58.716***	60.643***	59.943***	58.157***	64.198***	62.991***	55.637***
	(18.806)	(18.327)	(18.962)	(18.594)	(18.081)	(16.802)	(21.443)	(15.075)
Year 2008	72.195***	67.923***	70.839***	72.536***	67.959***	89.580***	72.373***	63.062***
	(22.788)	(21.386)	(22.333)	(22.784)	(21.284)	(23.335)	(24.804)	(17.300)
Year 2009	70.870***	67.522***	70.269***	70.755***	67.132***	85.457***	73.890***	54.794***
	(20.569)	(19.609)	(20.456)	(20.361)	(19.329)	(19.735)	(23.283)	(13.933)
Year 2010	31.269***	27.847***	34.600***	30.785***	27.087***	27.659***	32.177***	17.269***
	(9.337)	(8.317)	(10.239)	(9.117)	(8.023)	(6.568)	(10.442)	(4.523)
Year 2011	29.047***	24.823***	33.909***	29.113***	24.488***	33.294***	30.311***	21.334***
	(7.502)	(6.410)	(8.623)	(7.493)	(6.301)	(7.504)	(8.493)	(4.800)
1031			15.754***			13.800***		
			(6.525)			(4.400)		
Assemblage			33.202***			28.679*		
			(3.304)			(1.926)		
Build to Suit			34.558***			−20.924		
			(2.953)			(−1.450)		
Business Value			27.306			44.442**		
			(1.444)			(1.990)		
Condo Conversion			24.895**			−0.619		
			(2.369)			(−0.059)		
Contamination			−34.099			21.081		
			(−1.389)			(0.714)		
Deed Restriction			−4.167			−13.599		
			(−0.146)			(−0.407)		
Deferred Maintenance			−12.917**			−2.652		
			(−2.570)			(−0.413)		
Distressed Sale			−29.338***			26.802***		
Weighted				x	x	x		
Market Dummies	x	x	x	x	x	x		
Sale Condition Controls			x			x		
Submarket Dummies							x	

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variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**
			(−4.102)			(4.042)		
Ground Lease			8.166			−53.093***		
			(1.228)			(−11.459)		
High Vacancy			−17.996***			−45.991***		
			(−3.671)			(−10.146)		
Historical			17.775			49.023***		
			(1.378)			(3.974)		
Investor NNN			31.838***			23.600***		
			(7.580)			(5.427)		
Land Contract			−18.448			12.865		
			(−1.087)			(0.355)		
Option Sale			11.531			5.101		
			(1.360)			(0.568)		
Partial Interest			−55.724***			−97.510***		
			(−6.552)			(−20.716)		
Redevelopment			20.950***			−28.699***		
			(2.642)			(−3.438)		
REO			−42.397***			−55.092***		
			(−6.579)			(−7.223)		
Sale Leaseback			14.056***			8.140*		
			(3.138)			(1.931)		
Shell Condition			−4.274			−50.415***		
			(−0.357)			(−3.105)		
Short Sale			−30.964			15.228		
			(−1.578)			(0.652)		
Single Tenant			8.656***			11.049***		
			(4.905)			(4.507)		
Tenant Purchase			11.397***			25.355***		
			(2.607)			(4.643)		
Model N	25,515	25,515	25,515	25,515	25,515	25,515	25,515	25,515
R Square	0.360	0.365	0.373	0.364	0.369	0.473	0.515	0.143
Weighted				x	x	x		
Market Dummies	x	x	x	x	x	x		
Sale Condition Controls			x			x		
Submarket Dummies							x	

6.2. *Fixed Effect Regression*

Rent

To this point, the introduction and significance of the Professional Ownership related variables distinguished this research from the extant literature. However, the use of fixed effect regressions, a method I felt much better suited to the data, dramatically changed the results and significance levels of the sustainability variables. The fixed effect regressions were of similar form to Equation 2, with the addition of market or submarket fixed effects.

Table 12 shows the rent results for the Fixed Effect Regressions. Six Models are shown. Model 1 and Model 2 include submarket fixed effects, without and with professional ownership controls. Models 3 and 4 repeat the first two, but weighted by size. Models 5-6 used market fixed effects without and with professional ownership controls.

In my first rent Model, with submarket fixed effects, Energy Star showed a 3.8% premium, significant at the 5.0% level. Although no longer a significance level of 1%, the 3.8% premiums closely matched extant findings. LEED buildings demonstrated a whopping 16.8% premium at 1% significance. Curiously, Dual buildings showed no premium at all.

The most plausible explanation for the lack of a Dual building premium is that many Dual buildings likely achieved their Dual certification near or after 2008. LEED changed their requirements in 2009 to require all LEED buildings score a minimum of 69 on the Energy Star ranking.[9] With the hurdle rate only 75, many buildings became Energy Star as well. As such, many Dual buildings may have been leasing up during the financial crisis. Similarly, many LEED-only buildings may have written their leases during the real estate boom, and could explain a portion of the large rent premium.

The inclusion of the professional ownership variable considerably changed the results. First, the variable itself was significant at 1% in all specifications. In the

[9]LEED Reference Guide for Green Building Operations and Maintenance, USGBC

fixed effect regressions, professional owners commanded 5% market premiums.

Importantly, the statistical significance of Energy Star variable disappeared. This evidence strongly supports the potential link between effective management and price, rather than ESTAR alone commanding a premium. This finding supports the theory that market premiums more closely relate to professional ownership, and that there was a possible missing variable issue in the extant literature. Perhaps the Energy Star puzzle was merely missing a piece.

When I considered the heavy bias *towards variable significance* in the fixed effect regressions with submarket dummies, the finding for no ESTAR premiums were even more convincing. The fixed effect regressions reduced the N in the denominator of the standard deviation calculations by the number of clusters. Thus, a regression with 1,428 clusters biases towards variable significance through larger standard deviations and inflated T-Stats.

Sales

The sales data are shown in Table 13. Six Models are shown. Model 1 uses market fixed effects, Model 2 adds professional ownership controls, and Model 3 adds sale condition controls. Models 4-6 repeat the cycle, but weighted by Sale Price.

The sales data followed a similar, albeit not identical pattern to the OLSDV regressions. The first fixed effect regression showed both ESTAR and LEED as significant at \$31 and \$87 PSF respectively. Again, Dual showed no market premium. Using the mean PSF prices for ESTAR and LEED \$257 PSF and \$247 the premiums were 12% and 35% respectively.

All three professional ownership variables were significant at 5% or better. Again, the Prof Buyer variable showed a strong positive coefficient, contrary to expectations.

In Models 2 and 3, with professional ownership controls and the sale condition controls, ESTAR dropped to significant only at the 10% level, marginally significant by conventional standards. However, in Model 5, when I value weighted the sale prices by lnsales, ESTAR premium significance disappeared statistically. In Model

Table 12: This table presents a series of fixed effect regressions on lnrent. Models 1-4 used submarket fixed effects. Models 3 and 4 were both weighted by lnsize. Models 5 and 6 used market fixed effects. Models 2, 4, and 6 all include the Prof Owner variable. Results are the regression coefficient(T-Value). ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

Variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**
ESTAR	0.038**	0.020	0.038**	0.020	0.038	0.020
	(2.389)	(1.280)	(2.355)	(1.274)	(1.536)	(0.851)
LEED	0.168***	0.164***	0.170***	0.166***	0.168***	0.164***
	(6.248)	(6.150)	(6.160)	(6.054)	(4.618)	(4.655)
Dual	0.031	0.013	0.039	0.020	0.031	0.013
	(1.040)	(0.425)	(1.286)	(0.678)	(0.655)	(0.265)
Prof Owner		0.051***		0.052***		0.051***
		(6.312)		(6.378)		(3.195)
Intercept	2.336***	2.388***	2.333***	2.386***	2.336***	2.388***
	(42.396)	(44.578)	(40.819)	(43.065)	(20.503)	(22.841)
lnsize	0.026***	0.021***	0.027***	0.021***	0.026**	0.021*
	(4.425)	(3.582)	(4.408)	(3.591)	(2.239)	(1.923)
age100	−0.015	−0.016	−0.017	−0.018	−0.015	−0.016
	(−0.431)	(−0.440)	(−0.477)	(−0.484)	(−0.195)	(−0.198)
age75	0.034	0.033	0.036	0.036	0.034	0.033
	(0.980)	(0.972)	(1.007)	(0.999)	(0.395)	(0.393)
age50	−0.040	−0.041*	−0.042	−0.043*	−0.040	−0.041
	(−1.619)	(−1.662)	(−1.640)	(−1.682)	(−0.842)	(−0.869)
age40	−0.058***	−0.060***	−0.060***	−0.062***	−0.058*	−0.060*
	(−3.405)	(−3.562)	(−3.420)	(−3.586)	(−1.834)	(−1.920)
age30	−0.120***	−0.123***	−0.123***	−0.127***	−0.120***	−0.123***
	(−9.945)	(−10.226)	(−10.200)	(−10.498)	(−4.759)	(−4.881)
age20	−0.109***	−0.114***	−0.113***	−0.118***	−0.109***	−0.114***
	(−11.055)	(−11.604)	(−11.519)	(−12.094)	(−5.094)	(−5.329)
age15	−0.085***	−0.090***	−0.089***	−0.094***	−0.085***	−0.090***
	(−6.642)	(−7.020)	(−6.943)	(−7.344)	(−4.649)	(−4.855)
age10	−0.108***	−0.113***	−0.113***	−0.118***	−0.108***	−0.113***
	(−9.877)	(−10.394)	(−10.236)	(−10.778)	(−6.475)	(−6.709)
age5	−0.034***	−0.036***	−0.037***	−0.039***	−0.034**	−0.036**
	(−3.753)	(−3.985)	(−4.083)	(−4.348)	(−2.397)	(−2.559)
Renovated	0.019**	0.020***	0.017**	0.018**	0.019*	0.020*
	(2.521)	(2.685)	(2.172)	(2.337)	(1.679)	(1.808)
Percent Leased	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(17.197)	(17.294)	(16.850)	(16.948)	(8.521)	(8.544)
stories	0.009***	0.009***	0.008***	0.008***	0.009**	0.009**
	(4.786)	(4.933)	(4.465)	(4.617)	(2.328)	(2.387)
A Class	0.314***	0.307***	0.316***	0.309***	0.314***	0.307***
	(18.751)	(18.425)	(18.339)	(18.018)	(10.988)	(10.749)
B Class	0.149***	0.148***	0.151***	0.149***	0.149***	0.148***
	(17.138)	(17.030)	(16.528)	(16.424)	(12.007)	(11.976)
NNN	−0.148***	−0.149***	−0.154***	−0.155***	−0.148***	−0.149***
	(−14.401)	(−14.485)	(−14.205)	(−14.298)	(−5.882)	(−5.926)
FSG	0.061***	0.060***	0.060***	0.059***	0.061*	0.060*
	(5.405)	(5.347)	(5.036)	(4.975)	(1.810)	(1.794)
Amenity	0.007	0.006	0.006	0.006	0.007	0.006
	(0.971)	(0.871)	(0.933)	(0.825)	(0.426)	(0.382)
R-Square	0.2341	0.2359	0.2427	0.2447	0.2341	0.2359
Model N	48,630	48,630	48,630	48,630	48,630	48,630
Denominator DF	1,458	1,458	1,458	1,458	55	55
Submarket Fixed Effects	x	x	x	x		
Weighted			x	x		
Market Fixed Effects					x	x

6, also weighted, but including sale condition controls, ESTAR was again marginally significant, at the 10% level.

Value weighting changed the scale of the coefficients, and in some cases their significance. This provided support for my contention that value weighting deserves consideration in real estate regressions.

In summary, this section provided evidence that Professional Ownership significantly altered rent and sales prices. I provided strong evidence that contradicted prior findings of Energy Star premiums, instead demonstrating a link between management and Energy Star.

Table 13: This table presents a series of fixed effect regressions on sales PSF. Models 1 through 6 all used market fixed effects. Models 4-6 were weighted by lnsales. Models 2, 3, 5, and 6 all included the Professional buyer and seller related variables. Models 3 and 6 included a full suite of sale condition controls as well. Results are the regression coefficient(T-Value).***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

variable	Model1	Model2	Model3	Model4	Model5	Model6
ESTAR	31.236**	24.297*	25.557*	28.661*	22.053	23.323*
	(2.213)	(1.858)	(1.991)	(1.903)	(1.570)	(1.698)
LEED	87.271***	80.338***	79.249***	90.808***	83.493***	82.230***
	(4.304)	(4.340)	(4.176)	(4.556)	(4.588)	(4.386)
Dual	40.663	34.812	35.328	37.312	31.616	32.265
	(1.621)	(1.395)	(1.454)	(1.417)	(1.207)	(1.270)
Prof Buyer		43.612***	44.598***		41.387***	42.448***
		(4.197)	(4.462)		(4.115)	(4.389)
Prof Seller		66.419***	64.447***		67.956***	65.771***
		(3.589)	(3.590)		(3.655)	(3.659)
Prof Both		85.224**	86.524**		85.745**	86.744**
		(2.041)	(2.112)		(2.107)	(2.181)
Intercept	309.750***	325.852***	322.513***	319.918***	336.159***	332.764***
	(6.613)	(6.912)	(6.423)	(6.411)	(6.708)	(6.243)
lnsize	−4.001	−5.775	−6.016	−2.041	−3.869	−4.112
	(−0.727)	(−1.219)	(−1.266)	(−0.338)	(−0.741)	(−0.785)
age100	30.808	31.361	31.927	33.987	34.677	35.325
	(0.793)	(0.806)	(0.819)	(0.795)	(0.810)	(0.824)
age75	19.746	20.542	21.276	21.269	22.175	22.975
	(0.647)	(0.675)	(0.703)	(0.646)	(0.674)	(0.703)
age50	1.745	1.481	1.813	1.141	0.917	1.234
	(0.129)	(0.110)	(0.136)	(0.075)	(0.061)	(0.083)
age40	0.503	−0.121	0.885	−0.994	−1.619	−0.616
	(0.055)	(−0.014)	(0.100)	(−0.105)	(−0.174)	(−0.066)
age30	1.131	0.660	1.245	−1.547	−1.984	−1.334
	(0.123)	(0.072)	(0.137)	(−0.163)	(−0.209)	(−0.141)
age20	8.425	7.276	7.331	5.516	4.360	4.526
	(0.961)	(0.833)	(0.849)	(0.607)	(0.479)	(0.501)
age15	29.064***	28.564***	26.080***	27.009**	26.520**	24.052**
	(3.029)	(2.949)	(2.676)	(2.625)	(2.548)	(2.290)
age10	42.347***	41.929***	40.099***	40.638***	40.234***	38.447***
	(4.201)	(4.132)	(3.980)	(3.797)	(3.725)	(3.577)
age5	45.966***	45.841***	44.074***	45.930***	45.834***	43.988***
	(5.542)	(5.562)	(5.420)	(5.291)	(5.309)	(5.157)
stories	2.402*	2.357*	2.415**	2.269*	2.230*	2.270*
	(1.982)	(1.952)	(2.048)	(1.845)	(1.827)	(1.905)
A Class	77.081***	73.682***	73.633***	78.680***	75.375***	75.411***
	(8.661)	(9.079)	(8.875)	(8.227)	(8.544)	(8.328)
B Class	26.897***	26.640***	26.213***	27.410***	27.145***	26.795***
	(8.203)	(8.266)	(8.200)	(7.971)	(8.038)	(7.974)
lnland	−19.209**	−18.847**	−18.993**	−21.586**	−21.170**	−21.316**
	(−2.425)	(−2.423)	(−2.439)	(−2.528)	(−2.528)	(−2.539)
Amenity	6.623**	6.014**	5.583**	6.089**	5.440*	5.118*
Weighted				x	x	x
Market Fixed Effects	x	x	x	x	x	x
Sale Condition Controls			x			x

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variable	Model1	Model2	Model3	Model4	Model5	Model6
	(2.421)	(2.158)	(2.114)	(2.165)	(1.901)	(1.887)
Year 2002	7.508	7.135	6.785	8.234	7.810	7.319
	(1.465)	(1.414)	(1.386)	(1.455)	(1.405)	(1.357)
Year 2003	4.460	4.313	4.573	3.786	3.638	3.774
	(0.986)	(0.966)	(1.040)	(0.772)	(0.753)	(0.798)
Year 2004	10.950**	10.799**	11.628***	10.262**	10.100**	10.831**
	(2.507)	(2.463)	(2.705)	(2.200)	(2.166)	(2.377)
Year 2005	26.197***	25.507***	26.728***	26.143***	25.381***	26.499***
	(3.710)	(3.700)	(4.075)	(3.473)	(3.457)	(3.783)
Year 2006	49.048***	48.422***	49.163***	49.867***	49.187***	49.911***
	(4.550)	(4.556)	(4.705)	(4.280)	(4.282)	(4.402)
Year 2007	57.530***	55.637***	57.717***	58.948***	56.910***	58.945***
	(4.820)	(4.750)	(5.111)	(4.518)	(4.441)	(4.750)
Year 2008	67.825***	63.062***	66.190***	71.736***	66.589***	69.623***
	(3.627)	(3.440)	(3.727)	(3.416)	(3.228)	(3.472)
Year 2009	58.410***	54.794***	57.512***	62.559***	58.615***	61.154***
	(3.627)	(3.498)	(3.798)	(3.444)	(3.309)	(3.552)
Year 2010	21.001*	17.269	25.777**	24.747*	20.636	29.248**
	(1.765)	(1.531)	(2.395)	(1.874)	(1.648)	(2.446)
Year 2011	26.059	21.334	32.409**	32.063*	26.757	37.901**
	(1.639)	(1.403)	(2.297)	(1.827)	(1.590)	(2.444)
1031			30.850***			30.035***
			(6.556)			(6.282)
Assemblage			29.705**			31.015**
			(2.321)			(2.432)
Build to Suit			34.785***			32.860***
			(3.907)			(3.580)
Business Value			33.477			36.473
			(1.455)			(1.396)
Condo Conversion			39.717			41.729
			(1.531)			(1.559)
Contamination			−38.660			−42.629
			(−1.647)			(−1.636)
Deed Restriction			−10.167			−11.219
			(−1.015)			(−1.081)
Deferred Maintenance			−25.557***			−26.031***
			(−4.366)			(−4.506)
Distressed Sale			−24.476***			−24.133**
			(−3.162)			(−2.655)
Ground Lease			34.359***			35.609**
			(2.684)			(2.637)
High Vacancy			−14.744			−16.605
			(−1.299)			(−1.403)
Historical			−15.292			−17.234
			(−0.853)			(−0.916)
Investor NNN			28.855***			27.850***
			(5.567)			(4.804)
Land Contract			−63.382***			−66.669***
			(−6.218)			(−6.196)
Option Sale			17.728			15.834
			(1.513)			(1.227)
Partial Interest			−2.553			2.746
			(−0.152)			(0.171)
Redevelopment			29.319			29.703
			(1.415)			(1.372)
REO			−55.825***			−59.784***
			(−6.762)			(−6.978)
Sale Leaseback			20.730***			20.566***
			(4.769)			(4.540)
Shell Condition			11.792			8.048
			(1.036)			(0.712)
Short Sale			−44.145***			−49.211***
			(−3.027)			(−3.191)
Single Tenant			7.481**			7.810**
			(2.560)			(2.424)
Tenant Purchase			11.126***			11.740***
			(3.194)			(3.308)
R Square	0.137	0.143	0.156	0.144	0.150	0.162
Model N	25,515	25,515	25,515	25,515	25,515	25,515
Weighted				x	x	x
Market Fixed Effects	x	x	x	x	x	x
Sale Condition Controls			x			x

The Best Models and R-Squared

This article reported a variety of methods and techniques to estimate green building premiums. The criteria used to select the best models was a combination of statistical reliability, functional form, and R-Squared.

The R-Squared from a regression reports the percentage of the variance from the mean explained by the regression co-efficients. In its basic form, a higher R-Squared tends to suggest an improved model. However, when using Dummy Variables, that basic heuristic may not hold. Almost by definition, when dummy variables are added to a regression, the R-Squared increases. Consider if I were to add a dummy variable for each building in the rent regressions, 48,732 dummies with one building omitted. The R-squared would be near to 1.0, but the model would be a poor indicator of market trends.

Similarly, when I added 1,284 submarket dummies, the R-Squared trended higher. When I controlled with 55 market dummies, the R-Squared moved lower relative to the submarket dummies model. As discussed earlier, modern econometrics suggests that the overuse of dummy variables can lead to inconsistent estimators (Baltagi and Kao, 2001). More likely, the model with 55 market dummies effectively controls, in an OLSDV format, for market effects. Thus Model 6 in the OLSDV tables for rent, Table 10, and Model 3 in the OLSDV sales regression, Table 11 were the best OLSDV models. The rent model included the professional ownership controls, and the sale model included the professional buyer/seller and sale condition controls. They each used 55 market dummies as controls.

In a fixed effect model, the within transformation occurs prior to the regression. The markets have then been controlled for in each variable, and not in a single linear adjustment. But, the R-Squared for the model will not include the effect of the dummy variables. This does not diminish the explanatory power of the model relative to the OLSDV version. In fact, compare Models 7 and 8 in the OLSDV regressions, Table 10, which were purposefully shown with no market controls, to their counterparts, Models 5 and 6 in the fixed effect regressions, Table 12, and the R-Squared are *exactly* the same–0.2341 and 0.2359 respectively. The same comparison holds for the sales tables as well. The explanatory power based exclusively on the level of variance explained by the control variables are identical between the OLSDV with market dummies and the fixed effect by market.

The best models, producing the most reliable and consistent estimators, whose functional form best suits the data are the fixed effect models. The rent model with the most explanatory power is Model 6 from Table 12 and the sales is Model 3 from Table 13–the unweighted regressions which control for ownership and sale condition.

Additional Questions

After having established a link between ownership and price, and observing the distinct difference between fixed effect and OLSDV regressions, two important questions arose. First, how strong was the link between Professional Ownership and green buildings? Second, what, more specifically, in the data caused the distinct differences between the fixed effect and OLSDV regressions? The next two sections attempt to answer those questions.

6.3. Logistic Regression

To answer the question of how strong the relationship between professional ownership and green buildings is, I estimated a series of logistic regressions. In each regression the dependent variable was set to "1", so the interpretation of the coefficients was the likelihood that characteristics contributed towards a building being ESTAR, LEED, Dual or Professional ownership related variables. Table 14 shows the rent results, and Tables 15 and 16 show the sales results.

The rent results included two regressions for each green variable, one without market dummies and the second including them. The rent results showed clear causal relationships between Prof Owner and all green buildings. Particularly strong correlations appeared in the Energy Star and Dual buildings. An Energy Star or Dual building was roughly 4.5 times more likely to be owned by a Professional Owner than not. Similarly, Professionally Owned buildings were more than 4 times more likely to be Energy Star or Dual certified than not.

LEED correlations to Prof Owner were also significant at the 1% level, although of slightly smaller scale. One explanation for the smaller scale appeared in the sales logistic regressions in that LEED buildings were more likely to be single tenant buildings, while Dual and ESTAR were less likely to be single tenant. Single tenant buildings are often corporate headquarters and may be corporate, rather than professionally owned. Regardless, the correlation between LEED and Prof Owner was statistically significant.

In the sales data each variable underwent three regressions, first with no controls, then with market dummies, and finally with the sale condition controls added.

The distinction of Prof Buyer, Prof Seller and Prof Both offered some interesting findings. When I included sale condition controls, Energy Star buildings were more likely to be bought by a professional buyer, but no significance appeared on the Prof Seller. Thus, in the full model, Prof Sellers were not more likely to sell an Energy Star building. This pointed towards an acquisition bias of green buildings by professional owners, and provided a theoretical basis for professional buyer acquisition premiums.

For Dual buildings, again only Prof Buyer was significant, showing that professional buyers looked to acquire these types of properties, and were willing to pay a premium for them.

LEED buildings appeared likely to be exchanged by two professional owners, but no other ownership variable showed as statistically significant.

The propensity of green buildings to be larger appeared clear in both the rent and sales logistic regressions. The coefficients on lnsize were both large and highly significant in each regression. This suggested that not only were green buildings much more likely to be larger, but that professional owners purchased larger buildings as well. The increased likelihood of larger buildings being green lent further support to potential size bias in unweighted regressions.

Table 14:

This table presents results from logistic regression of the rent data with the dependent variable set to "1". Each of the three green real estate variables and the professional ownership (Prof Owner) variable were tested as the dependent variable. Each dependent variables was tested with and without market dummies. Results are the likelihood estimate (WaldChiSq). ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

Dependent	ESTAR Model1	ESTAR Model2	LEED Model3	LEED Model4	Dual Model5	Dual Model6	Prof Owner Model7	Prof Owner Model8
ESTAR			−16.186	−15.401	−17.554	−17.988	1.416***	1.409***
			(0.002)	(0.004)	(0.006)	(0.007)	(758.503)	(712.525)
LEED	−18.200	−18.328			−17.906	−18.097	0.630***	0.500***
	(0.000)	(0.000)			(0.001)	(0.001)	(19.778)	(11.874)
Dual	−19.552	−20.059	−16.991	−16.351			1.448***	1.455***
	(0.001)	(0.001)	(0.001)	(0.002)			(202.164)	(192.899)
Prof Owner	1.486***	1.506***	0.508***	0.436***	1.446***	1.493***		
	(819.886)	(778.619)	(10.713)	(6.778)	(183.623)	(167.587)		
Intercept	−34.558	−36.122	−33.539	−32.371	−52.839	−55.323	−13.103***	−15.031***
	(0.044)	(0.049)	(0.021)	(0.062)	(0.046)	(0.053)	(3098.41)	(1700.37)
lnsize	1.063***	1.147***	1.108***	1.051***	1.714***	1.841***	0.927***	0.974***
	(559.280)	(555.243)	(100.543)	(74.186)	(303.801)	(277.021)	(1706.20)	(1728.97)
age100	−0.030	0.204	−3.093***	−3.296***	−2.096***	−1.870***	0.108	0.064
	(0.012)	(0.512)	(56.419)	(58.026)	(10.415)	(7.751)	(0.845)	(0.276)
age75	0.149	0.394*	−3.811***	−3.788***	−1.191***	−0.583	0.323***	0.214**
	(0.438)	(2.782)	(88.732)	(81.996)	(12.274)	(2.443)	(10.457)	(4.023)
age50	0.229	0.357	−3.691***	−3.656***	−0.865**	−0.520	0.217*	0.201*
	(0.771)	(1.729)	(47.575)	(44.817)	(4.947)	(1.547)	(3.587)	(2.870)
age40	0.305	0.414*	−3.805***	−3.901***	−1.100***	−0.976***	0.673***	0.676***
	(2.124)	(3.551)	(103.480)	(96.247)	(12.849)	(8.268)	(59.392)	(55.708)
age30	0.623***	0.633***	−4.799***	−5.018***	−1.139***	−1.267***	0.885***	0.923***
	(11.120)	(10.473)	(143.180)	(144.083)	(18.051)	(18.007)	(145.664)	(149.115)
age20	0.947***	0.945***	−4.534***	−4.749***	−0.634***	−0.713***	1.145***	1.157***
	(29.152)	(26.716)	(309.908)	(305.892)	(8.051)	(8.185)	(295.799)	(285.703)
age15	0.935***	1.019***	−3.853***	−4.215***	−0.718**	−0.673*	1.069***	1.072***
	(18.892)	(20.819)	(40.595)	(45.042)	(4.352)	(3.138)	(123.048)	(118.971)
age10	1.107***	1.183***	−3.617***	−3.794***	0.053	−0.080	1.100***	1.085***
	(36.283)	(38.383)	(113.875)	(120.196)	(0.048)	(0.091)	(217.398)	(202.540)
age5	1.065***	1.100***	−3.038***	−3.278***	−0.022	−0.116	0.668***	0.634***
	(32.366)	(32.152)	(110.200)	(119.645)	(0.008)	(0.181)	(76.636)	(66.367)
Renovated	−0.040	0.029	1.488***	1.600***	0.005	0.222	−0.199***	−0.167***
	(0.226)	(0.112)	(43.104)	(45.474)	(0.001)	(1.593)	(15.361)	(10.487)
Percent Leased	0.011***	0.012***	0.000	0.000	0.013***	0.014***	−0.002***	−0.002***
	(57.738)	(60.134)	(0.003)	(0.018)	(18.241)	(17.534)	(10.628)	(11.106)
stories	−0.003	−0.004	−0.006	0.008	0.009	0.009	−0.050***	−0.056***
	(0.620)	(0.590)	(0.423)	(0.530)	(2.152)	(1.508)	(289.449)	(333.399)
A Class	1.623***	1.771***	3.156***	3.077***	13.300	13.482	1.053***	0.988***
	(66.068)	(75.986)	(9.618)	(9.004)	(0.005)	(0.005)	(270.732)	(222.149)
B Class	1.006***	1.019***	2.521**	2.446**	12.315	12.208	0.622***	0.582***
	(27.281)	(27.555)	(6.229)	(5.820)	(0.004)	(0.004)	(145.894)	(123.369)
NNN	0.352***	0.069	0.333*	0.106	1.172***	0.330*	0.131***	0.113**
	(17.393)	(0.457)	(3.330)	(0.241)	(60.537)	(2.883)	(9.555)	(6.103)
FSG	0.513***	0.251***	0.149	−0.257	0.668***	0.090	0.182***	0.049
	(75.126)	(9.702)	(0.843)	(1.553)	(29.899)	(0.274)	(32.286)	(1.614)
Amenity	16.314	16.286	16.054	15.147	14.382	14.276	0.159***	0.191***
	(0.010)	(0.010)	(0.005)	(0.014)	(0.008)	(0.009)	(20.846)	(27.247)
Model N	48,630	48,630	48,630	48,630	48,630	48,630	48,630	48,630
AIC	11,269	10,684	1,893	1,819	3,181	2,806	34,101	33,337
SIC	11,462	11,361	2,086	2,496	3,374	3,483	34,295	34,014
Market Dummies		X		X		X		X

Table 15: This table presents results from logistic regression of the sales data with the dependent variable set to “1”. Each of the three green real estate variables and the three professional ownership (Prof Buyer, Prof Seller and Prof Both) were tested as the dependent variable. The Prof variables are shown in Table 16 Each dependent variable was tested first with no controls, then with market dummies added, and then with sale condition controls added. Results are the likelihood estimate (WaldChiSq). ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

Dependent variable	**ESTAR**			**LEED**			**DUAL**		
	Model1	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**
ESTAR				−15.556	−14.871	−14.870	−16.839	−14.345	−14.320
				(0.002)	(0.005)	(0.005)	(0.004)	(0.053)	(0.057)
LEED	−18.507	−17.405	−17.484				−17.553	−14.549	−14.698
	(0.000)	(0.000)	(0.000)				(0.000)	(0.005)	(0.006)
Dual	−19.292	−18.826	−18.880	−16.103	−15.306	−15.244			
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)			
Prof Buyer	1.113***	1.045***	1.002***	0.166	0.110	0.113	0.837***	0.535***	0.471**
	(94.874)	(76.057)	(68.115)	(0.299)	(0.117)	(0.120)	(20.350)	(6.693)	(4.854)
Prof Seller	0.492**	0.429*	0.373	0.670*	0.808**	0.598	0.250	−0.056	−0.040
	(4.458)	(3.092)	(2.301)	(3.328)	(3.883)	(1.993)	(0.453)	(0.019)	(0.009)
Prof Both	1.636***	1.471***	1.344***	1.789***	1.792***	1.807***	0.299	−0.587	−0.625
	(24.452)	(17.470)	(14.471)	(9.255)	(7.822)	(7.920)	(0.172)	(0.472)	(0.525)
Intercept	−34.661	−35.905	−35.955	−27.085	−26.506	−26.490	−35.535	−47.532	−49.520
	(0.022)	(0.068)	(0.068)	(0.025)	(0.071)	(0.069)	(0.030)	(0.020)	(0.030)
lnsize	1.506***	1.562***	1.574***	0.879***	0.810***	0.826***	1.965***	2.213***	2.291***
	(396.394)	(365.324)	(356.509)	(38.227)	(26.856)	(26.278)	(217.085)	(205.962)	(204.816)
age100	−0.717*	−0.343	−0.432	−1.767***	−2.073***	−2.104***	−4.132***	−3.208***	−3.411***
	(3.384)	(0.704)	(1.073)	(17.195)	(20.498)	(20.097)	(14.764)	(8.407)	(9.347)
age75	−0.481	−0.002	−0.111	−2.370***	−2.496***	−2.478***	−2.531***	−1.456***	−1.724***
	(2.172)	(0.000)	(0.097)	(33.059)	(32.708)	(31.361)	(33.519)	(8.577)	(10.953)
age50	−0.726**	−0.435	−0.490	−1.934***	−2.043***	−2.084***	−2.183***	−1.306**	−1.598***
	(4.034)	(1.289)	(1.598)	(23.371)	(23.011)	(22.947)	(21.102)	(5.892)	(8.176)
age40	−0.420	−0.246	−0.370	−1.917***	−2.076***	−2.044***	−2.172***	−1.715***	−1.878***
	(1.665)	(0.517)	(1.120)	(29.443)	(30.478)	(28.842)	(25.268)	(12.426)	(13.814)
age30	−0.123	−0.067	−0.242	−2.548***	−2.760***	−2.708***	−2.276***	−2.270***	−2.472***
	(0.171)	(0.045)	(0.557)	(58.185)	(59.680)	(55.587)	(31.574)	(23.275)	(25.360)
age20	0.094	0.109	−0.060	−3.039***	−3.260***	−3.210***	−1.603***	−1.537***	−1.756***
	(0.114)	(0.137)	(0.039)	(116.257)	(113.250)	(105.581)	(22.100)	(14.747)	(17.321)
age15	0.455	0.605*	0.537	−2.636***	−2.837***	−2.876***	−1.787***	−1.841***	−1.947***
	(1.856)	(2.944)	(2.220)	(18.385)	(19.881)	(19.734)	(11.110)	(8.725)	(8.805)
age10	0.825***	0.880***	0.762**	−2.939***	−3.208***	−3.239***	−0.313	−0.400	−0.545
	(7.855)	(8.010)	(5.685)	(36.134)	(39.952)	(39.745)	(0.690)	(0.850)	(1.445)
age5	0.604**	0.650**	0.563*	−2.246***	−2.373***	−2.374***	−0.528	−0.489	−0.612
	(4.174)	(4.354)	(3.120)	(37.827)	(38.319)	(37.026)	(2.071)	(1.317)	(1.914)
stories	−0.035***	−0.020***	−0.021***	−0.038**	−0.020	−0.024	−0.019**	−0.002	−0.004
	(27.934)	(7.397)	(7.578)	(4.686)	(1.115)	(1.545)	(4.631)	(0.030)	(0.122)
A Class	2.006***	2.064***	1.991***	1.602***	1.441***	1.541***	1.000**	1.345***	1.234**
	(52.199)	(53.097)	(48.686)	(14.384)	(10.302)	(11.525)	(4.787)	(7.635)	(6.210)
B Class	1.130***	1.110***	1.066***	1.093***	0.947**	0.995***	0.208	0.291	0.232
	(17.838)	(16.864)	(15.343)	(8.857)	(6.342)	(6.906)	(0.213)	(0.377)	(0.229)
Market Dummies		x	x		x	x		x	x
Sale Condition Controls			x			x			x

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Dependent variable		**ESTAR**			**LEED**			**DUAL**	
	Model1	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**
lnland	−0.239***	−0.179***	−0.147***	−0.109	0.012	−0.018	−0.451***	−0.441***	−0.439***
	(30.946)	(13.807)	(8.920)	(1.431)	(0.014)	(0.030)	(40.736)	(27.629)	(26.158)
Amenity	16.398	15.315	15.273	14.955	13.957	14.013	15.107	11.598	11.814
	(0.005)	(0.012)	(0.012)	(0.008)	(0.020)	(0.019)	(0.005)	(0.068)	(0.077)
Year 2002	−0.351	−0.370	−0.365	0.493	0.479	0.404	−0.318	−0.176	−0.257
	(2.186)	(2.296)	(2.206)	(0.688)	(0.636)	(0.448)	(0.561)	(0.155)	(0.315)
Year 2003	0.130	0.127	0.148	−0.817	−0.777	−0.856	−0.110	−0.121	−0.152
	(0.368)	(0.333)	(0.449)	(0.938)	(0.836)	(1.010)	(0.075)	(0.079)	(0.121)
Year 2004	−0.212	−0.224	−0.256	−0.213	−0.212	−0.317	−0.047	0.167	0.009
	(1.043)	(1.091)	(1.418)	(0.111)	(0.107)	(0.238)	(0.016)	(0.178)	(0.000)
Year 2005	−0.335*	−0.278	−0.320	0.299	0.360	0.308	−0.110	0.120	−0.070
	(2.901)	(1.880)	(2.456)	(0.298)	(0.424)	(0.307)	(0.100)	(0.103)	(0.034)
Year 2006	0.047	0.112	0.062	−0.032	−0.066	−0.109	0.018	0.094	−0.044
	(0.065)	(0.344)	(0.103)	(0.003)	(0.013)	(0.036)	(0.003)	(0.065)	(0.014)
Year 2007	−0.159	−0.114	−0.148	0.071	0.094	−0.025	−0.198	0.044	−0.148
	(0.756)	(0.356)	(0.601)	(0.017)	(0.029)	(0.002)	(0.348)	(0.014)	(0.163)
Year 2008	−0.431**	−0.321	−0.352*	0.292	0.411	0.322	−0.608*	−0.318	−0.505
	(5.197)	(2.681)	(3.175)	(0.317)	(0.612)	(0.368)	(2.948)	(0.682)	(1.660)
Year 2009	−0.740***	−0.530**	−0.529**	0.649	0.679	0.654	−0.487	0.042	−0.058
	(10.427)	(4.934)	(4.869)	(1.560)	(1.635)	(1.476)	(1.537)	(0.010)	(0.017)
Year 2010	−0.536**	−0.394*	−0.295	0.916*	0.945*	0.843	−0.683*	−0.332	−0.342
	(5.981)	(2.967)	(1.567)	(3.315)	(3.356)	(2.607)	(2.853)	(0.569)	(0.558)
Year 2011	−0.620***	−0.506**	−0.467*	0.882*	0.869	0.814	−0.447	−0.163	−0.263
	(6.820)	(4.256)	(3.436)	(2.872)	(2.640)	(2.236)	(1.218)	(0.142)	(0.343)
1031			−0.452***			−0.758*			−0.712*
			(7.272)			(2.745)			(3.635)
Assemblage			−0.209			0.677			−11.173
			(0.038)			(0.406)			(0.001)
Build to Suit			−0.706			−0.846			−0.889
			(1.123)			(0.529)			(0.587)
Business Value			−15.465			1.341			−11.809
			(0.000)			(0.886)			(0.000)
Condo Conversion			−15.546			−13.465			−11.295
			(0.000)			(0.000)			(0.001)
Contamination			−15.588			−13.526			−11.108
			(0.000)			(0.000)			(0.000)
Deed Restriction			−14.300			−11.328			−9.896
			(0.000)			(0.000)			(0.000)
Deferred Maintenance			−0.152			−0.199			−12.230
			(0.150)			(0.069)			(0.005)
Distressed Sale			−0.698			−0.622			−2.628**
			(1.948)			(0.535)			(4.213)
Ground Lease			−0.405*			0.313			−0.702
			(2.751)			(0.450)			(2.481)
High Vacancy			−0.286			0.181			−0.929*
			(1.373)			(0.190)			(2.960)
Historical			0.225			−13.998			0.767
			(0.108)			(0.000)			(0.719)
Investor NNN			0.244			−0.156			0.233
Market Dummies		x	x		x	x		x	x
Sale Condition Controls			x			x			x

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continued from previous page

Dependent variable	**Model1**	**ESTAR Model2**	**Model3**	**Model4**	**LEED Model5**	**Model6**	**Model7**	**DUAL Model8**	**Model9**
			(1.176)			(0.083)			(0.408)
Land Contract			−11.698			−12.340			−7.444
			(0.000)			(0.000)			(0.000)
Option Sale			−0.550			−0.213			−1.603
			(0.680)			(0.036)			(1.567)
Partial Interest			0.159			0.847			0.471
			(0.241)			(2.297)			(0.991)
Redevelopment			−15.400			1.117*			2.517***
			(0.000)			(2.782)			(11.142)
REO			−1.268*			−0.519			0.209
			(3.613)			(0.728)			(0.059)
Sale Leaseback			−0.490*			−0.990			−0.594
			(3.422)			(1.711)			(1.518)
Shell Condition			−0.684			−0.366			−11.524
			(0.363)			(0.179)			(0.001)
Short Sale			−14.168			−14.098			0.236
			(0.000)			(0.000)			(0.003)
Single Tenant			−0.655***			0.393*			−0.407
			(16.752)			(2.905)			(1.782)
Tenant Purchase			−0.081			0.559			−1.222
			(0.043)			(1.331)			(1.910)
Model N	25, 515	25, 515	25, 515	25, 515	25, 515	25, 515	25, 515	25, 515	
AIC	4, 408	4, 242	4, 227	, 1342	1, 328	1, 353	1, 594	1, 472	, 1472
SIC	4, 661	, 4942	, 5114	, 1595	2, 029	2, 241	1, 846	2, 172	2, 360
Market Dummies		x	x		x	x		x	x
Sale Condition Controls			x			x			x

Table 16: This table presents results from logistic regression of the sales data with the dependent variable set to “1”. Each of the three green real estate variables and the three professional ownership (Prof Buyer, Prof Seller and Prof Both) were tested as the dependent variable. The green variables are shown in Table 15 Each dependent variables was tested first with no controls, then with market dummies added, and then with sale condition controls added. Results are the likelihood estimate (WaldChiSq). ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

		Prof Buyer			**Prof Seller**			**Prof Both**	
variable	**Model10**	**Model11**	**Model12**	**Model13**	**Model14**	**Model15**	**Model16**	**Model17**	**Model18**
ESTAR	0.982***	0.856***	0.841***	0.305	0.167	0.112	1.516***	1.252***	1.147***
	(77.005)	(53.622)	(50.782)	(1.853)	(0.514)	(0.225)	(21.773)	(11.950)	(9.419)
LEED	0.150	0.082	−0.032	0.983***	0.884**	0.897**	1.603***	1.671***	1.621**
	(0.251)	(0.074)	(0.011)	(7.970)	(5.984)	(5.929)	(6.993)	(6.659)	(5.512)
Dual	0.822***	0.600***	0.554***	0.266	0.016	−0.060	0.490	−0.532	−0.625
	(22.296)	(10.766)	(8.997)	(0.634)	(0.002)	(0.028)	(0.674)	(0.647)	(0.823)
Prof Buyer				−16.094	−16.176	−15.169	−14.325	−12.581	−12.654
				(0.002)	(0.002)	(0.005)	(0.004)	(0.033)	(0.036)
Prof Seller	−15.233	−15.441	−15.368				−14.269	−13.028	−13.058
	(0.004)	(0.005)	(0.005)				(0.001)	(0.012)	(0.013)
Prof Both	−15.518	−15.790	−15.781	−16.249	−16.522	−15.477			
	(0.002)	(0.002)	(0.002)	(0.000)	(0.000)	(0.001)			
Intercept	−16.643***	−31.500	−31.651	−16.562***	−18.091***	−18.538***	−28.929	−39.663	−40.012
	(504.289)	(0.006)	(0.006)	(205.341)	(127.329)	(130.711)	(0.021)	(0.016)	(0.017)
lnsize	1.103***	1.071***	1.088***	0.710***	0.632***	0.678***	1.316***	1.274***	1.301***
	(264.968)	(225.482)	(222.489)	(50.942)	(38.050)	(42.220)	(31.873)	(23.295)	(22.832)
age100	−0.430	−0.104	−0.059	−0.127	0.074	0.110	−1.111	0.257	0.482
	(2.406)	(0.125)	(0.040)	(0.072)	(0.023)	(0.049)	(0.876)	(0.041)	(0.142)
age75	−0.724***	−0.362	−0.317	0.117	0.287	0.261	−0.788	0.525	0.518
	(8.569)	(1.879)	(1.388)	(0.102)	(0.545)	(0.431)	(0.824)	(0.310)	(0.278)
age50	−0.309	−0.107	−0.088	0.270	0.323	0.316	−0.085	0.758	0.658
	(1.414)	(0.157)	(0.101)	(0.474)	(0.624)	(0.577)	(0.008)	(0.554)	(0.375)
age40	0.194	0.170	0.124	0.201	0.123	0.077	0.503	0.731	0.486
	(0.787)	(0.547)	(0.279)	(0.308)	(0.108)	(0.041)	(0.436)	(0.762)	(0.309)
age30	−0.067	−0.022	−0.049	0.334	0.360	0.309	0.443	0.676	0.448
	(0.111)	(0.010)	(0.052)	(1.199)	(1.325)	(0.937)	(0.386)	(0.733)	(0.300)
age20	0.225	0.222	0.170	0.822***	0.858***	0.832***	0.942	1.405**	1.158
	(1.620)	(1.440)	(0.800)	(9.820)	(10.219)	(9.115)	(2.363)	(4.284)	(2.668)
age15	−0.102	−0.077	−0.095	−0.123	−0.057	−0.134	1.274*	1.605*	1.757**
	(0.144)	(0.077)	(0.115)	(0.065)	(0.014)	(0.074)	(2.836)	(3.625)	(4.052)
age10	0.133	0.089	0.088	0.366	0.326	0.296	1.410**	1.822**	1.629**
	(0.399)	(0.166)	(0.155)	(1.170)	(0.887)	(0.712)	(4.182)	(5.575)	(4.143)
age5	−0.022	−0.017	−0.049	0.327	0.338	0.291	0.627	1.044	0.991
	(0.011)	(0.006)	(0.050)	(1.035)	(1.060)	(0.762)	(0.765)	(1.763)	(1.439)
stories	−0.044***	−0.030***	−0.030***	−0.008	0.003	0.005	−0.056***	−0.005	−0.006
	(41.732)	(16.622)	(16.831)	(0.579)	(0.085)	(0.251)	(7.053)	(0.056)	(0.063)
A Class	1.478***	1.320***	1.261***	1.538***	1.389***	1.415***	1.551*	1.005	0.865
	(53.331)	(40.470)	(36.164)	(21.015)	(16.403)	(16.770)	(3.443)	(1.323)	(0.959)
B Class	0.935***	0.818***	0.816***	1.330***	1.230***	1.248***	0.764	0.348	0.312
	(27.708)	(20.745)	(20.344)	(21.170)	(17.807)	(18.283)	(0.984)	(0.195)	(0.153)
Market Dummies		x	x		x	x		x	x
Sale Condition Controls			x			x			x

Continued on next page

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	Prof Buyer			Prof Seller			Prof Both		
variable	**Model10**	**Model11**	**Model12**	**Model13**	**Model14**	**Model15**	**Model16**	**Model17**	**Model18**
lnland	−0.234***	−0.124***	−0.111**	0.004	0.137*	0.126*	−0.568***	−0.348**	−0.297*
	(31.707)	(7.322)	(5.735)	(0.003)	(3.760)	(3.104)	(20.440)	(5.335)	(3.697)
Amenity	0.575***	0.542***	0.505***	0.472***	0.521***	0.542***	0.890*	0.719	0.598
	(25.335)	(21.319)	(18.156)	(8.479)	(9.586)	(10.118)	(3.158)	(1.924)	(1.301)
Year 2002	0.024	0.029	0.050	1.435*	1.388*	1.350*	10.775	8.584	8.632
	(0.002)	(0.002)	(0.006)	(3.180)	(2.955)	(2.790)	(0.003)	(0.017)	(0.017)
Year 2003	0.174	0.167	0.165	0.877	0.820	0.815	−0.222	−0.457	−0.424
	(0.101)	(0.092)	(0.089)	(1.087)	(0.942)	(0.930)	(0.000)	(0.000)	(0.000)
Year 2004	0.876*	0.903*	0.889*	0.421	0.379	0.389	−0.210	−0.218	−0.237
	(3.418)	(3.588)	(3.447)	(0.235)	(0.189)	(0.199)	(0.000)	(0.000)	(0.000)
Year 2005	1.814***	1.878***	1.833***	−0.067	−0.066	−0.078	11.149	9.124	9.111
	(17.266)	(18.305)	(17.318)	(0.005)	(0.005)	(0.007)	(0.003)	(0.019)	(0.019)
Year 2006	1.882***	1.934***	1.918***	0.875	0.857	0.877	9.960	7.758	7.772
	(19.003)	(19.845)	(19.369)	(1.245)	(1.188)	(1.242)	(0.002)	(0.013)	(0.014)
Year 2007	2.564***	2.653***	2.627***	1.716**	1.729**	1.735**	11.923	9.855	9.890
	(36.617)	(38.762)	(37.701)	(5.337)	(5.387)	(5.413)	(0.004)	(0.022)	(0.022)
Year 2008	3.462***	3.604***	3.600***	3.102***	3.186***	3.210***	13.297	11.619	11.748
	(67.980)	(72.651)	(71.871)	(18.579)	(19.468)	(19.696)	(0.004)	(0.030)	(0.032)
Year 2009	2.935***	3.087***	3.118***	3.215***	3.299***	3.343***	13.610	11.974	11.987
	(46.519)	(50.716)	(51.279)	(19.598)	(20.475)	(20.967)	(0.005)	(0.032)	(0.033)
Year 2010	2.870***	3.081***	3.125***	3.377***	3.500***	3.624***	13.127	11.476	11.550
	(44.819)	(50.847)	(51.458)	(21.904)	(23.345)	(24.889)	(0.004)	(0.030)	(0.030)
Year 2011	2.928***	3.057***	3.070***	3.527***	3.561***	3.716***	13.662	11.936	11.842
	(45.296)	(48.630)	(48.304)	(23.583)	(23.860)	(25.783)	(0.005)	(0.032)	(0.032)
1031			−0.576***			−0.078			−1.688
			(9.019)			(0.084)			(2.472)
Assemblage			0.791			0.529			−9.935
			(1.389)			(0.205)			(0.001)
Build to Suit			0.054			0.136			−8.521
			(0.005)			(0.017)			(0.001)
Business Value			−0.080			−14.187			−9.741
			(0.004)			(0.000)			(0.000)
Condo Conversion			−1.297			−13.935			−10.077
			(1.603)			(0.000)			(0.001)
Contamination			2.132*			−12.017			−7.588
			(3.783)			(0.000)			(0.000)
Deed Restriction			−13.209			−12.892			−6.545
			(0.000)			(0.000)			(0.000)
Deferred Maintenance			−0.389			0.250			−10.590
			(1.066)			(0.316)			(0.008)
Distressed Sale			−1.134**			−14.144			0.447
			(4.283)			(0.001)			(0.199)
Ground Lease			0.211			−0.636			−0.265
			(0.806)			(1.883)			(0.117)
High Vacancy			0.391**			−0.450			0.292
			(4.459)			(1.552)			(0.213)
Historical			−2.012*			−14.025			−11.642
			(3.385)			(0.000)			(0.001)
Investor NNN			0.462*			0.179			0.018
Market Dummies		x	x		x	x		x	x
Sale Condition Controls			x			x			x

Continued on next page

continued from previous page

variable	Model10	Prof Buyer Model11	Model12	Model13	Prof Seller Model14	Model15	Model16	Prof Both Model17	Model18
			(3.613)			(0.185)			(0.000)
Land Contract			−11.587			−11.501			−6.140
			(0.000)			(0.000)			(0.000)
Option Sale			−13.919			0.271			−10.036
			(0.001)			(0.278)			(0.003)
Partial Interest			−0.632*			−0.412			−0.024
			(3.336)			(0.884)			(0.001)
Redevelopment			−0.987			−0.151			−9.762
			(2.399)			(0.040)			(0.002)
REO			−0.365			−1.518**			−10.988
			(1.048)			(4.288)			(0.005)
Sale Leaseback			−0.099			−2.514**			−0.669
			(0.187)			(6.097)			(0.370)
Shell Condition			−0.392			−0.458			−9.693
			(0.347)			(0.194)			(0.001)
Short Sale			0.520			−13.329			−8.302
			(0.359)			(0.000)			(0.000)
Single Tenant			−0.411***			0.214			−1.968*
			(8.685)			(1.515)			(3.625)
Tenant Purchase			−13.539			0.230			−8.921
			(0.004)			(0.433)			(0.006)
Model N	25,515	25,515	25,515	25,515	25,515	25,515	25,515	25,515	
AIC	5,146	5,053	5,008	2,451	2,379	2,380	642	646	669
SIC	5,398	5,754	5,896	2,703	3,080	3,268	895	1,346	1,557
Market Dummies		x	x		x	x		x	x
Sale Condition Controls			x			x			x

6.4. By Market Regression

The clear differences between the OLSDV regressions and the fixed effect regressions merited further investigation beyond the econometric distinctions. What, more specifically, in the data caused the distinct differences between the fixed effect and OLSDV regressions?

Since clustering by market generated such different results than linear dummy variable adjustments, exploring each individual market in detail represented the first path of investigation. To avoid the issue of different market demand/supply factors influencing other markets, I individually regressed each market. Results for the variables of interest are shown for rent in Table 17 and for sales in Tables 18 and 19.

Interestingly, in Model 1 and 2, which are most similar to the extant literature without the Prof Owner variable, only seven of the markets showed Energy Star as significant at the 5% level, but South Florida (99N) and Oklahoma City (1N) were negative signficant!

LEED buildings appeared at 5% or better significance in only three markets, and at 10% in as little as four markets, depending on the model.

Dual buildings appeared in only four markets, with the professional ownership control, at 5% or better significance, and at 10% in only seven markets–including Buffalo (1N) as negative significant.

If only 10% of the markets demonstrated positive ESTAR premiums, what drove the premiums in the macro regression? The same question held with LEED and Dual buildings; only a small sample of markets individually demonstrated significant green premiums.

A few careful observation from the market by market regressions, along with a close look at the descriptive statistics offered some clues. Looking through the market by market regressions, several variables appeared to economically unrealistic. For example, in New York City Dual building market premiums of roughly 50% most likely derived from characteristics other than simply the Dual label. In San Jose, it was unlikely that Energy Star buildings command a 20% + market premiums purely based on the ESTAR label.

I particularly point out New York City and San Jose (as part of the San Francisco MSA) because, as shown in Table 4, New York City's average non-green-building rent of $50.63 PSF was more than 2/3 higher than the next closest, San Francisco at $30.20 PSF, and roughly twice as high the third ranked market, Washington DC at $25.46.[10]

Buildings in the most expensive and second most expensive MSA's demonstrated market premiums unlikely to be wholly accounted for by green labeling. What econometric effect would this have on the green dummies in an OLSDV regression? Even though these buildings may not appear like total outliers relative to their market peers, it would be reasonable to assume their impact could be disproportionate on the green subset.

[10] Although San Jose is often considered a distinct MSA from San Francisco, I considered Marin County and San Jose as part of the San Francisco MSA for discussion purposes. The two markets are less than an hour apart, and leasing decisions may be made between the two markets, and East Bay/Oakland, by numerous firms.

Table 17: Each market was individually regressed on lnrent. Results are shown for the sustainable real estate variables of interest, ESTAR, LEED, and Dual. Results are also shown for the Prof Owner variable. Models 1 and 2 do not include the Prof Owner variable, Models 3 and 4 do include it. Models 1 and 3 include submarket dummies. Full regression results are presented in the appendix. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	ESTAR					LEED					Dual					Prof Owner		
Market Name	**N**	**Model1**	**Model2**	**Model3**	**Model4**	**N**	**Model1**	**Model2**	**Model3**	**Model4**	**N**	**Model1**	**Model2**	**Model3**	**Model4**	**Model3**	**Model4**	
Atlanta	112	0.001	0.036	−0.000	0.035	7	0.022	0.102	0.022	0.102	42	0.005	0.007	0.004	0.007	0.004	0.003	
Austin	31	0.000	0.004	0.014	0.017	6	−0.024	−0.131	−0.024	−0.129	12	0.042	0.046	0.058	0.062	−0.032	−0.031	
Baltimore	3	0.070	−0.019	0.069	−0.015	10	0.106	0.059	0.106	0.058	2	−0.087	−0.097	−0.086	−0.100	0.002	−0.007	
Birmingham	4	−0.036	−0.058	−0.030	−0.047	0	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	−0.026	−0.039	
Boston	29	−0.027	−0.061	−0.050	−0.086	6	0.365***	0.294*	0.356***	0.282*	8	0.134	0.010	0.115	−0.014	0.059**	0.064*	
Buffalo/Niagara Falls	3	0.209	0.207	0.215	0.208	0	0.000	0.000	0.000	0.000	1	−0.439*	−0.448*	−0.427*	−0.445*	0.257	0.055	
Charlotte	48	0.038	0.015	0.040	0.016	9	−0.038	0.024	−0.036	0.025	7	0.016	0.109	0.020	0.111	−0.005	−0.003	
Chicago	145	−0.012	−0.022	−0.004	−0.015	6	0.153	0.169	0.161	0.176	63	0.002	0.034	0.009	0.040	−0.022	−0.018	
Cincinnati/Dayton	15	−0.045	−0.069	−0.034	−0.059	6	0.147	0.125	0.149	0.126	2	−0.099	−0.104	−0.092	−0.096	−0.042	−0.041	
Cleveland	12	0.040	0.048	0.041	0.046	4	0.177	0.186	0.179	0.181	2	0.081	0.067	0.082	0.067	−0.012	0.046	
Columbus	8	0.174*	0.162*	0.171*	0.159	0	0.000	0.000	0.000	0.000	2	−0.017	−0.021	−0.021	−0.026	0.022	0.024	
Dallas/Ft Worth	126	0.045**	0.023	0.032	0.010	13	0.029	0.077	0.027	0.076	31	0.129***	0.150***	0.114***	0.135***	0.031**	0.031*	
Denver	105	0.071***	0.062**	0.024	0.015	13	−0.023	−0.033	−0.016	−0.031	57	0.065*	0.075*	0.003	0.016	0.121***	0.113***	
Detroit	32	0.062	0.053	0.061	0.053	0	0.000	0.000	0.000	0.000	1	0.011	−0.016	0.017	−0.014	0.009	0.003	
East Bay/Oakland	47	0.088**	0.099*	0.086*	0.092*	5	0.127	0.204	0.127	0.204	15	0.042	0.020	0.039	0.009	0.005	0.014	
Hampton Roads	14	0.049	0.032	0.063	0.057	2	−0.012	−0.003	−0.005	0.012	1	−0.204	−0.174	−0.185	−0.138	−0.030	−0.046	
Hartford	11	0.016	0.033	0.019	0.036	1	0.105	0.124	0.106	0.125	0	0.000	0.000	0.000	0.000	0.068	0.051	
Houston	122	0.051**	0.052**	0.057**	0.060**	8	0.056	0.059	0.054	0.055	45	0.112***	0.068	0.118***	0.076*	−0.029*	−0.034*	
Indianapolis	18	−0.076	−0.084	−0.090	−0.096	1	0.315	0.339	0.292	0.329	2	0.170	0.154	0.142	0.128	0.080*	0.048	
Inland Empire (California	25	0.040	0.025	−0.012	−0.034	3	−0.074	−0.104	−0.056	−0.082	0	0.000	0.000	0.000	0.000	0.067	0.077*	
Jacksonville (Florida)	8	−0.012	−0.054	−0.020	−0.059	0	0.000	0.000	0.000	0.000	2	0.026	−0.011	0.029	−0.010	0.022	0.012	
Kansas City	14	−0.035	−0.025	−0.035	−0.035	3	0.259*	0.255*	0.259*	0.265*	3	0.008	−0.012	0.008	−0.035	0.001	0.040	
Las Vegas	5	0.244*	0.175	0.220	0.146	5	0.133	0.167	0.133	0.168	0	0.000	0.000	0.000	0.000	0.043	0.048	
Long Island (New York)	7	0.063	−0.159	0.056	−0.166	1	−0.252	−0.280	−0.241	−0.270	0	0.000	0.000	0.000	0.000	0.041	0.035	
Los Angeles	238	0.037*	0.033	0.030	0.038	11	0.074	0.115	0.072	0.117	54	0.073*	0.135***	0.068	0.139***	0.014	−0.011	
Louisville	12	0.002	−0.020	0.008	−0.007	1	0.211	0.241	0.211	0.241	0	0.000	0.000	0.000	0.000	−0.011	−0.024	
Marin/Sonoma	7	0.149	0.247*	0.174	0.281**	0	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.114	0.148*	
Memphis	3	0.019	0.060	−0.018	−0.003	1	0.096	0.154	0.065	0.098	0	0.000	0.000	0.000	0.000	0.089	0.135**	
Milwaukee/Madison	23	0.030	0.014	0.060	0.057	3	0.091	0.149	0.118	0.189	4	−0.046	−0.011	−0.014	0.033	−0.056	−0.077**	
Minneapolis/St Paul	73	−0.031	−0.004	−0.030	−0.004	3	0.001	0.036	−0.002	0.035	23	−0.012	0.012	−0.010	0.013	−0.009	−0.004	
Nashville	19	0.039	0.016	0.042	0.020	5	0.101	0.150	0.099	0.145	5	0.060	0.055	0.062	0.057	−0.006	−0.010	
New Orleans/ Metairie/ Ke	9	−0.016	0.004	−0.023	−0.005	0	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.059	0.073	
New York City	46	0.064	0.050	0.062	0.038	3	0.180	0.350	0.178	0.336	10	0.464***	0.505***	0.462***	0.493***	0.011	0.054	
Northern New Jersey	30	0.053	0.083	0.046	0.070	2	−0.162	−0.090	−0.164	−0.102	1	0.036	0.042	0.016	0.008	0.030	0.049**	
Oklahoma City	1	−0.739***	−0.588**	−0.753***	−0.615**	0	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.017	0.033	
Orange (CA)	143	0.032	0.040	0.033	0.040	5	0.122	0.223*	0.122	0.223*	20	−0.036	−0.058	−0.035	−0.058	−0.003	−0.001	
Orlando	21	−0.047	−0.072	−0.056	−0.078	3	0.002	0.001	−0.014	−0.015	1	−0.208	−0.404	−0.231	−0.427	0.052*	0.037	
Philadelphia	54	0.016	0.023	0.007	0.012	6	0.253**	0.269**	0.242**	0.261**	6	0.036	0.046	0.030	0.038	0.037**	0.039**	
Phoenix	74	0.028	0.056*	0.013	0.044	8	−0.064	−0.081	−0.065	−0.081	14	0.039	0.075	0.023	0.063	0.039**	0.030*	
Pittsburgh	8	0.052	0.060	0.031	0.053	2	0.019	−0.082	0.026	−0.080	0	0.000	0.000	0.000	0.000	0.031	0.011	
Portland	49	−0.013	0.057	−0.008	0.064	16	0.002	0.016	0.003	0.015	6	−0.021	−0.048	−0.014	−0.041	−0.046*	−0.060**	
Providence	1	0.082	0.076	0.087	0.080	0	0.000	0.000	0.000	0.000	1	−0.296	−0.402	−0.290	−0.399	0.041	0.022	
Raleigh/Durham	21	−0.012	−0.010	−0.028	−0.031	2	0.201	0.159	0.192	0.148	0	0.000	0.000	0.000	0.000	0.035	0.045	
Richmond VA	16	0.024	0.002	0.025	0.003	0	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	−0.002	−0.009	
Sacramento	67	0.096***	0.085**	0.107***	0.088**	4	0.171	0.220*	0.171	0.221*	17	0.047	0.045	0.058	0.047	−0.025	−0.006	
Salt Lake City	10	0.010	0.016	0.036	0.046	1	−0.023	−0.036	0.004	−0.003	1	0.176	0.168	0.200	0.198	−0.035	−0.043	
San Antonio	28	0.036	0.046	0.033	0.043	1	0.253	0.252	0.254	0.255	2	0.054	0.080	0.050	0.076	0.020	0.020	
San Diego	65	0.060	0.014	0.075**	0.021	4	0.310***	0.201	0.315***	0.202	11	0.070	0.044	0.084	0.052	−0.039	−0.016	
San Francisco	60	−0.013	0.054	−0.013	0.049	3	0.100	0.122	0.100	0.114	40	0.020	0.123	0.020	0.117	0.002	0.030	
Seattle/Puget Sound	47	0.008	−0.000	−0.006	−0.019	19	0.086	0.124**	0.080	0.115*	33	−0.012	0.016	−0.027	−0.005	0.031	0.045**	
South Bay/San Jose	34	0.114**	0.206***	0.106*	0.196***	6	0.038	0.300*	0.043	0.311*	9	0.350***	0.306**	0.334***	0.284**	0.031	0.040	
South Florida	99	−0.042	−0.078**	−0.047*	−0.085***	10	0.056	0.023	0.056	0.023	21	0.006	0.029	0.000	0.021	0.011	0.015	
St. Louis	11	−0.044	−0.021	−0.043	−0.032	4	0.120	0.054	0.119	0.064	1	0.049	−0.097	0.053	−0.119	−0.005	0.032	
Tampa/St Petersburg	32	0.014	0.047	0.005	0.021	2	0.017	0.064	0.015	0.059	5	−0.007	0.041	−0.022	−0.001	0.025	0.063**	
Washington DC	219	0.011	0.067***	0.008	0.064***	43	0.006	0.097**	0.003	0.094**	44	0.019	0.112***	0.015	0.108**	0.021**	0.021*	
Westchester/So Connecticut	9	0.041	0.028	0.035	0.025	1	0.044	0.180	0.044	0.180	1	0.182	0.244	0.159	0.233	0.024	0.012	
Submarket Dummies		X		X			X		X			X		X		X		
Prof Owner Included				X	X				X	X				X	X		X	X

Table 18: Each market was individually regressed on sales PSF. Results are shown for the sustainable real estate variables of interest, ESTAR, LEED, and Dual. Results are also shown for the Professional ownership variables in Table 19. Model 1 does not include any market, ownership or sale condition controls. Model 2 adds the Professional Ownership controls. Model 3 adds sale condition controls. Model 4 adds submarket dummy controls. Full regression results are presented in the appendix.***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	ESTAR					LEED					Dual				
Market	**Model1**	**Model2**	**Model3**	**Model4**	**N**	**Model1**	**Model2**	**Model3**	**Model4**	**N**	**Model1**	**Model2**	**Model3**	**Model4**	**N**
Atlanta	28.819**	28.686**	24.845**	9.405	33	−32.254	−32.401	−30.220	−6.911	1	18.760	18.226	17.570	16.529	18
Austin	54.077*	59.862*	74.861**	79.877**	8	213.017***	212.314***	114.608	62.703	2	14.199	18.267	19.740	2.545	3
Baltimore	58.617**	63.147**	53.389**	65.669**	5	62.820**	72.545**	79.569**	64.648*	3	−153.16***	−154.72***	−147.69***	−148.18***	1
Birmingham	−129.77**	−129.77**	−122.08*	−149.98*	1	275.026***	275.026***	263.397***	270.119***	1	0.000	0.000	0.000	0.000	
Boston	11.293	3.811	−4.141	−7.331	30	26.521	18.879	4.304	31.113	13	−109.76*	−124.57**	−148.06**	−83.972*	5
Buffalo/Niagara Falls	−115.31	−115.31	−116.87	−81.028	1	207.235***	207.235***	171.745***	160.572***	1	0.000	0.000	0.000	0.000	
Charlotte	56.243*	54.494	41.212	68.778**	9	49.659	50.856	52.994	36.236	2	−47.837	−36.257	−48.647	14.935	1
Chicago	17.592	14.373	12.589	20.085*	64	116.249***	118.692***	117.008***	114.787***	4	27.443*	26.811*	25.529*	37.933***	37
Cincinnati/Dayton	14.134	16.327	6.932	7.662	6	−6.091	−5.311	13.396	4.007	7	−18.285	−16.395	−9.973	−9.898	1
Cleveland	−11.284	−11.284	9.611	22.258	4	−8.049	−10.195	−13.177	−3.047	3	−10.630	−8.954	−0.843	−2.200	1
Columbus	29.489	35.622	35.922	34.551	2	0.000	0.000	0.000	0.000		5.788	5.312	15.840	21.629	1
Dallas/Ft Worth	4.976	4.677	3.356	4.441	42	−11.854	−17.914	−21.622	−24.040	6	27.073	27.725	22.674	17.613	8
Denver	24.869**	14.468	15.168	11.649	52	39.619*	35.473	31.979	45.398**	8	57.305***	50.660***	53.336***	32.036**	26
Detroit	55.438*	56.077*	54.374*	62.634**	3	51.523	53.743	63.180	65.887	1	140.659***	149.317***	149.082***	156.684***	2
East Bay/Oakland	−33.946	−32.985	−28.967	−26.749	12	73.980	81.430*	62.903	59.900	3	17.535	−32.500	−84.939*	−60.848	5
Hampton Roads	47.527	77.296**	86.044**	26.150	4	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000	
Hartford	55.017	50.608	47.689	85.472	2	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000	
Houston	10.221	11.305	12.851	7.205	43	0.000	0.000	0.000	0.000		35.317***	35.211***	36.366***	36.134***	21
Indianapolis	−65.601	−27.843	−75.918	−66.542	5	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000	
Inland Empire (California	47.874	46.236	60.919	34.994	1	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000	
Jacksonville (Florida)	15.937	11.977	5.505	8.543	5	−46.786	−46.347	−41.857	−57.101	1	0.000	0.000	0.000	0.000	
Kansas City	30.676	34.823	49.656**	51.902**	5	0.000	0.000	0.000	0.000		56.957	59.810	52.187	58.177	1
Las Vegas	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000		−108.30	−108.00	−111.14	−113.26	1
Long Island (New York)	64.959	61.775	109.580	143.500*	4	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000	
Los Angeles	45.529***	45.182***	47.300***	29.018***	79	98.937***	100.145***	95.705***	72.174***	9	68.641***	66.482***	70.527***	52.243***	19
Louisville	157.655*	159.875*	170.318**	195.480**	1	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000	
Marin/Sonoma	68.055	68.055	66.730	79.524	1	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000	
Memphis	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000	
Milwaukee/Madison	−34.120	−62.138*	−48.605	−46.865	9	67.487	56.913	47.453	67.118	1	0.000	0.000	0.000	0.000	
Minneapolis/St Paul	17.539	18.391	16.525	17.192	22	42.601*	43.882*	35.381	43.097*	5	−15.342	−24.396	−35.568	−28.029	7
Nashville	−60.967	−93.470	−93.299	−61.209	1	94.402	97.598	64.739	55.927	2	22.445	24.755	11.177	−19.268	1
New Orleans/Metairie/Ke	40.096	52.372	68.390	68.386	2	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000	
New York City	11.455	−9.525	−1.209	22.084	43	57.026	50.795	27.535	28.883	6	26.682	31.410	29.831	18.687	12
Northern New Jersey	34.744***	32.909***	32.561***	32.545***	31	81.698**	75.567**	75.885**	85.373**	3	30.364	32.576	29.821	24.211	7
Oklahoma City	0.000	0.000	0.000	0.000		150.815**	150.381*	149.612**	148.039**	1	0.000	0.000	0.000	0.000	
Orange (California)	71.335***	68.900***	62.524***	46.262***	27	−34.424	−32.879	−35.626	−33.699	1	80.576***	83.952***	76.111**	63.412**	9
Orlando	−7.489	−13.761	−11.717	−12.398	15.000	49.771	47.808	63.454	33.037	3	33.280	37.574	48.224	46.405	3
Philadelphia	−0.395	−2.410	−3.594	1.139	22	38.798	51.003	62.569	93.878**	3	−34.483	−40.055	−40.830	−44.867	4
Phoenix	39.030***	40.188***	36.560***	23.583**	34	21.518	19.060	−46.969	−82.599	2	134.989***	136.831***	129.408***	103.499***	7
Pittsburgh	15.537	17.619	34.170	51.315	2	46.830	49.189	46.378	35.844	1	0.000	0.000	0.000	0.000	
Portland	30.328	28.330	29.146	14.955	12	5.032	3.101	3.693	1.441	9	−49.128	−52.345	−32.578	−28.012	3
Providence	0.000	0.000	0.000	0.000		11.869	11.869	−1.062	−8.818	1	0.000	0.000	0.000	0.000	
Raleigh/Durham	50.891	6.817	43.682	45.719	3	−65.279	−59.346	−78.343	−83.250	1	0.000	0.000	0.000	0.000	
Richmond VA	−10.524	−11.572	−23.850	−52.083	2	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000	
Sacramento	25.024	30.856*	20.164	27.849*	24	11.394	10.053	11.944	6.122	2	3.726	6.073	16.471	20.973	6
Salt Lake City	4.645	4.645	−124.12	568.584	2	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000	
San Antonio	−5.295	−3.297	−11.239	30.907	6	22.280	27.403	−2.462	1.643	1	0.000	0.000	0.000	0.000	
San Diego	−7.852	−16.012	−14.884	−6.224	30	16.260	15.694	19.135	13.701	5	10.996	6.368	11.595	−4.711	6
San Francisco	56.148**	58.557**	66.803***	48.057**	40	66.969	66.887	106.580*	77.706	4	123.433***	128.159***	132.070***	104.090***	17
Seattle/Puget Sound	43.978*	39.122	37.561	26.479	14	60.244**	69.354**	84.783***	81.985***	11	37.632	24.844	21.631	2.696	8
South Bay/San Jose	55.351	34.577	−9.205	27.534	7	516.919***	540.860***	512.544***	213.937**	4	35.594	10.360	49.294	−86.603	1
South Florida	15.635	13.375	14.937	25.658	37	−3.907	−1.779	−16.894	−10.099	6	65.672**	62.943**	59.473**	68.033***	14
St. Louis	9.862	2.994	3.680	7.814	7	102.796*	98.959*	84.814*	109.600**	2	0.000	0.000	0.000	0.000	
Tampa/St Petersburg	35.261	29.600	27.434	29.058	9	12.116	−37.008	−14.768	−28.759	1	33.606	−20.605	−36.936	−29.048	2
Washington DC	59.606***	54.273***	58.549***	47.698***	108	130.363***	116.534***	123.219***	84.493***	17	65.978***	69.910***	72.860***	59.215***	37
Westchester/So Connecticu	−1.128	−1.610	0.443	−3.412	2	−78.172	−78.579	−77.396	−59.131	1	0.000	0.000	0.000	0.000	
Prof Owner Controls		x	x	x			x	x	x			x	x	x	
Sale Condition Controls			x	x				x	x				x	x	
Submarket Dummy Controls				x					x					x	

Table 19: Extension of Table 18, showing Professional ownership variables. Model 1 omitted. Model 2 includes the Professional Ownership controls, but no sale condition or submarket controls. Model 3 adds sale condition controls. Model 4 adds submarket dummy controls. Results are the regression coefficient(T-Value).***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	Prof Buyer				Prof Seller				Prof Both			
Market	**Model2**	**Model3**	**Model4**	**N**	**Model2**	**Model3**	**Model4**	**N**	**Model2**	**Model3**	**Model4**	**N**
Atlanta	2.197	5.543	7.010	46	20.162	22.365	28.787*	12	61.191	56.020	30.692	1
Austin	−90.093	−86.515	−127.59*	1	76.014	68.065	51.931	1	0.000	0.000	0.000	
Baltimore	−17.186	−20.020	−19.961	12	−19.192	−19.610	−11.006	6	0.000	0.000	0.000	
Birmingham	0.000	0.000	0.000		0.000	0.000	0.000		0.000	0.000	0.000	
Boston	54.979***	57.890***	20.775	34	78.861*	70.123	39.379	5	0.000	0.000	0.000	
Buffalo/Niagara Falls	0.000	0.000	0.000		0.000	0.000	0.000		0.000	0.000	0.000	
Charlotte	1.795	21.173	6.103	10	46.739	110.114	94.473	1	53.690	53.614	39.389	1
Chicago	16.212	17.234	12.427	36	21.415	21.563	9.299	22	36.763	35.779	38.943	8
Cincinnati/Dayton	12.113	1.053	14.113	4	36.928	40.181	43.844	4	0.000	0.000	0.000	
Cleveland	7.788	26.585	25.499	5	2.503	18.201	22.323	2	0.000	0.000	0.000	
Columbus	−14.070	−10.631	−8.096	5	−48.637	−48.860	−47.172	1	0.000	0.000	0.000	
Dallas/Ft Worth	8.483	6.772	8.593	28	−17.697	−9.784	−8.645	3	40.811	28.047	39.835	2
Denver	34.232***	32.697***	29.005***	50	31.608*	30.740*	21.009	12	2.089	3.123	12.993	6
Detroit	76.644**	82.676***	75.225***	3	28.103	41.721	31.528	1.000	0.000	0.000	0.000	
East Bay/Oakland	96.159***	118.739***	108.703***	7	107.370*	80.762	115.413**	2	0.000	0.000	0.000	
Hampton Roads	14.415	11.023	23.929	9	−12.984	−14.839	−19.069	2	−106.50*	−96.483*	−43.137	1
Hartford	−9.978	−27.572	14.985	1	−31.258	−30.780	−29.512	1	0.000	0.000	0.000	
Houston	3.606	5.659	3.225	33	25.205**	24.211**	20.967*	15	−45.253	−32.017	−19.824	2
Indianapolis	−135.93	21.049	7.737	4	14.641	−7.183	−14.922	5	0.000	0.000	0.000	
Inland Empire (California	−22.825	−19.969	−17.589	4	0.000	0.000	0.000		0.000	0.000	0.000	
Jacksonville (Florida)	3.556	7.449	7.544	4	14.832	19.027	15.954	2	0.000	0.000	0.000	
Kansas City	−10.238	−25.461	−21.767	6	4.983	−0.841	−8.868	7	0.000	0.000	0.000	
Las Vegas	46.886	27.455	17.616	4	−69.987	−68.587	−71.842	1	0.000	0.000	0.000	
Long Island (New York)	4.683	−15.360	5.004	9	84.090	89.886	55.258	3	70.423	83.991	103.053	1
Los Angeles	11.886	10.095	−2.886	52	62.892**	56.366*	54.096**	10	−66.279	−46.188	−4.653	3
Louisville	38.900	51.352	63.865	1	0.000	0.000	0.000		0.000	0.000	0.000	
Marin/Sonoma	0.000	0.000	0.000		0.000	0.000	0.000		0.000	0.000	0.000	
Memphis	4.726	35.223	66.137	2.000	0.000	0.000	0.000		0.000	0.000	0.000	
Milwaukee/Madison	57.754	55.363	62.603	5	10.090	17.333	2.832	4	0.000	0.000	0.000	
Minneapolis/St Paul	16.093	18.308	16.695	16	30.079	17.440	25.193	1	45.867	45.892	47.890	2
Nashville	39.656	26.002	62.360	2	24.027	0.684	3.510	2	0.000	0.000	0.000	
New Orleans/Metairie/Ke	−15.533	−22.054	−6.536	2	0.000	0.000	0.000		0.000	0.000	0.000	
New York City	202.147***	200.942***	114.378**	45	93.117	96.095	91.194	22	810.693**	811.403**	523.263	1
Northern New Jersey	24.309*	19.286	9.024	23	58.133*	46.411	40.666	4	24.365	22.865	31.370	1
Oklahoma City	−10.458	−56.957	−89.533	1	0.000	0.000	0.000		0.000	0.000	0.000	
Orange (California)	−4.712	−9.701	13.356	11	31.310	18.944	−2.172	4	119.836	114.430	90.497	1
Orlando	34.591	35.103	21.739	9	12.424	−14.070	−16.692	2	15.492	−42.079	−6.013	1
Philadelphia	37.209***	36.082***	21.052*	26	−2.252	−0.519	−3.141	22	−23.823	−24.243	−48.469	2
Phoenix	−8.880	−4.249	−3.648	36	−11.605	−19.915	−10.131	9	−93.259	−93.274	−142.51**	1
Pittsburgh	8.551	34.799	44.471	3	46.136	42.777	39.738	1	0.000	0.000	0.000	
Portland	22.841	18.551	8.858	13	13.520	−13.789	−19.591	2	0.000	0.000	0.000	
Providence	0.000	0.000	0.000		0.000	0.000	0.000		0.000	0.000	0.000	
Raleigh/Durham	71.984***	73.181***	79.892***	10	65.997**	65.322**	47.667	5	30.876	30.543	−0.546	1
Richmond VA	−30.241	−36.156	−43.271	3	11.336	18.990	23.453	1	−67.042	−78.637	−34.799	1
Sacramento	−38.593*	−27.577	−31.861	10	−24.908	−29.688	−38.705	3	0.000	0.000	0.000	
Salt Lake City	0.000	0.000	0.000		0.000	0.000	0.000		0.000	0.000	0.000	
San Antonio	8.472	11.462	15.336	8	0.000	0.000	0.000	1.000	0.000	0.000	0.000	
San Diego	51.552***	54.836***	57.004***	24	−13.682	−1.002	−0.771	7	9.831	12.156	−4.304	1
San Francisco	−17.482	−16.535	−8.805	23	11.009	−12.574	−24.481	5	13.189	6.238	17.893	1
Seattle/Puget Sound	34.738*	35.334*	22.463	26	48.528*	53.538**	21.036	11	126.987***	136.987***	100.766**	4
South Bay/San Jose	176.139***	189.848***	161.594***	6	502.423***	488.397***	291.867***	2	0.000	0.000	0.000	
South Florida	22.044	22.306	31.116*	29	320.822***	325.140***	348.640***	1	0.000	0.000	0.000	
St. Louis	49.156**	50.659**	23.218	10	21.056	25.994	−0.360	8	0.000	0.000	0.000	
Tampa/St Petersburg	50.911**	55.896**	53.889**	9	−3.942	−4.925	−11.999	2	71.458	75.546	75.225	1
Washington DC	43.649***	43.424***	32.590***	129	71.299***	75.577***	65.746***	48	86.790***	95.447***	61.394***	24
Westchester/So Connecticu	0.000	0.000	0.000		−10.031	−16.268	−15.098	1.000	0.000	0.000	0.000	
Sale Condition Controls		x	x			x	x			x	x	
Submarket Dummy Controls			x				x				x	

Using just OLSDV regressions, as per the extant literature, I examined the impact of removing certain markets from the whole country regression in Table 20. New York City was removed first, and then San Jose. Several other markets like Washington DC, San Diego, or Boston may also strongly impact results in an OLSDV regression, but only the effect of these two were reported to conserve space.

Models 1 and 2 repeat the earlier regression including submarket controls with and without Prof Owner for ease of comparison in the table. Model 3 and 4 omitted all New York City buildings, with and without the Prof Owner variable. Model 5 and 6 omitted all San Francisco buildings, with and without the Prof Owner variable. Models 7 and 8 omitted both the New York City and San Jose buildings, with and without the Prof Owner variable.

Removing either market with the Prof Owner dropped the significance of ESTAR to 10%. More importantly, removing just the two highest nominal markets removed the significance of ESTAR altogether, when the Prof Owner variable was included, and to just 10% significance without the Prof Owner variable. Even replicating prior work, in the form of OLSDV, yielded significantly different results via the omission of just two markets. Importantly those markets did not disproportionately adjust the N of ESTAR or LEED buildings.

This brief examination of the impact of one or two market provided further support for the argument that linear adjustments to rent in the form of dummy variables may bias the results. Fixed effects models more accurately control for market level effects in large national databases, like CoStar.

Table 20: Models 1 and 2 repeat the earlier regression with submarket controls with and without prof owner for display purposes. Model 3 and 4 omits all New York City buildings, with and without the Prof Owner variable. Model 5 and 6 omits all San Jose buildings, with and without the Prof Owner variable. Models 7 and 8 omit both the New York City and San Jose buildings, with and without the Prof Owner variable. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

variable	Model1	Model2	Model3	Model4	Model5	Model6	Model7	Model8
ESTAR	0.017***	0.013**	0.016***	0.011*	0.016***	0.012*	0.014**	0.010
	(2.934)	(2.124)	(2.665)	(1.823)	(2.718)	(1.945)	(2.444)	(1.638)
LEED	0.099***	0.098***	0.096***	0.095***	0.097***	0.096***	0.093***	0.093***
	(6.270)	(6.222)	(6.122)	(6.073)	(6.071)	(6.024)	(5.919)	(5.872)
Dual	0.035***	0.030***	0.024**	0.019*	0.031***	0.026**	0.020*	0.015
	(3.080)	(2.649)	(2.119)	(1.671)	(2.725)	(2.316)	(1.750)	(1.324)
Prof Owner		0.013***		0.014***		0.013***		0.013***
		(3.727)		(3.889)		(3.565)		(3.725)
Intercept	2.838***	2.852***	2.826***	2.841***	2.837***	2.850***	2.825***	2.839***
	(65.340)	(65.425)	(65.933)	(66.030)	(65.296)	(65.366)	(65.898)	(65.980)
lnsize	0.030***	0.028***	0.031***	0.029***	0.030***	0.029***	0.031***	0.029***
	(15.131)	(14.278)	(15.642)	(14.762)	(15.108)	(14.286)	(15.628)	(14.780)
age100	−0.166***	−0.167***	−0.167***	−0.167***	−0.167***	−0.167***	−0.167***	−0.168***
	(−20.256)	(−20.284)	(−20.140)	(−20.173)	(−20.232)	(−20.257)	(−20.123)	(−20.154)
age75	−0.176***	−0.176***	−0.170***	−0.170***	−0.175***	−0.176***	−0.170***	−0.170***
	(−23.694)	(−23.720)	(−22.699)	(−22.719)	(−23.585)	(−23.609)	(−22.587)	(−22.605)
age50	−0.194***	−0.194***	−0.193***	−0.194***	−0.193***	−0.194***	−0.193***	−0.193***
	(−26.921)	(−26.958)	(−27.025)	(−27.066)	(−26.739)	(−26.774)	(−26.846)	(−26.885)
age40	−0.177***	−0.178***	−0.177***	−0.177***	−0.177***	−0.177***	−0.177***	−0.177***
	(−28.403)	(−28.465)	(−28.682)	(−28.745)	(−28.205)	(−28.266)	(−28.485)	(−28.548)
age30	−0.174***	−0.175***	−0.175***	−0.175***	−0.174***	−0.175***	−0.174***	−0.175***
	(−34.045)	(−34.138)	(−34.566)	(−34.665)	(−33.856)	(−33.945)	(−34.384)	(−34.479)
age20	−0.153***	−0.154***	−0.153***	−0.154***	−0.153***	−0.154***	−0.153***	−0.154***
	(−33.391)	(−33.550)	(−33.854)	(−34.023)	(−33.329)	(−33.479)	(−33.800)	(−33.961)
age15	−0.087***	−0.088***	−0.087***	−0.088***	−0.087***	−0.088***	−0.087***	−0.088***
	(−11.226)	(−11.354)	(−11.408)	(−11.544)	(−11.181)	(−11.304)	(−11.366)	(−11.495)
age10	−0.084***	−0.085***	−0.083***	−0.084***	−0.083***	−0.084***	−0.083***	−0.084***
	(−14.755)	(−14.910)	(−14.879)	(−15.043)	(−14.577)	(−14.726)	(−14.700)	(−14.859)
age5	−0.027***	−0.027***	−0.026***	−0.027***	−0.026***	−0.026***	−0.026***	−0.026***
	(−4.976)	(−5.041)	(−4.965)	(−5.034)	(−4.847)	(−4.907)	(−4.833)	(−4.898)
Renovated	0.037***	0.037***	0.034***	0.035***	0.037***	0.038***	0.035***	0.035***
	(8.165)	(8.212)	(7.642)	(7.688)	(8.238)	(8.282)	(7.715)	(7.757)
Percent Leased	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
	(20.282)	(20.342)	(20.457)	(20.520)	(20.205)	(20.262)	(20.381)	(20.441)
stories	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(5.125)	(5.231)	(6.282)	(6.393)	(5.102)	(5.205)	(6.263)	(6.370)
A Class	0.233***	0.232***	0.229***	0.228***	0.233***	0.232***	0.229***	0.228***
	(43.265)	(42.894)	(42.861)	(42.471)	(43.071)	(42.713)	(42.673)	(42.296)
B Class	0.113***	0.113***	0.113***	0.112***	0.113***	0.113***	0.113***	0.113***
	(35.431)	(35.358)	(35.543)	(35.464)	(35.403)	(35.332)	(35.522)	(35.445)
NNN	−0.102***	−0.102***	−0.102***	−0.102***	−0.102***	−0.103***	−0.102***	−0.102***
	(−28.890)	(−28.935)	(−29.253)	(−29.302)	(−28.928)	(−28.970)	(−29.298)	(−29.344)
FSG	0.106***	0.106***	0.106***	0.106***	0.106***	0.106***	0.106***	0.106***
	(35.145)	(35.139)	(35.639)	(35.630)	(35.245)	(35.237)	(35.750)	(35.739)
Amenity	0.006**	0.005*	0.006**	0.006**	0.006**	0.006**	0.006**	0.006**
	(2.023)	(1.950)	(2.130)	(2.054)	(2.049)	(1.977)	(2.157)	(2.083)
R Square	0.609	0.609	0.580	0.580	0.608	0.608	0.577	0.578
ESTAR N	2473	2473	2427	2427	2413	2413	2367	2367
LEED N	278	275	272	272	272	272	269	269
Dual N	628	618	608	608	578	578	568	568
Markets Removed	N/A	N/A	No NYC	No NYC	No SJ	No SJ	No NYC or SJ	No NYC or SJ

Notes on Sale Condition Controls

Although not primary to the research topics of this paper, the evidence presented in the sale price and logistic regressions on the sale condition controls provided rich avenues for discussion and future research.

Several results were intuitive, such as the sale price reduction for Distressed Sale, REO, or Short Sale, but some findings open up areas for future research. 1031 exchanges tended to increase price, but professional buyers were less likely to be involved in one. Professional buyers tended to avoid single tenant buildings, despite their ease of operation. What were the driver for the investor NNN premium, and to what does it correlate? The initial findings here with respect to sale condition factors offer a starting point for further research.

7. Robustness Checks

7.1. Non Parametric Test

The subject research questioned whether green buildings labels, in and of themselves, caused rental and sales premiums. Professional management was shown to impact rent and sales prices. Another potential explanation for green premiums is that green buildings contain similar characteristics to non-green buildings that generate premium rent for other reasons. In other words, if the green label were ignored, would eco-buildings be otherwise statistically similar to premium buildings in the market? Comparing non-green high rent buildings to green buildings tests whether the eco label itself drives the premium. The results provide limited support for this theory.

I tested this hypothesis through a series of non-parametric tests. Results are shown in Tables 21 and 22. Green buildings, ESTAR, LEED, and Dual were examined independently in three different ways. First all green buildings were separated into a subset, and all non-green buildings into a subset.

I regressed the non-green subset in two sets of rent estimations and two sets of sale estimations. The purpose was to subset as described below, using the different methods outlined in the body of the paper. Model 1 was an OLSDV regression with basic controls, market dummies, and no green variable dummies or ownership/buyer/seller control variables. Model 2 mirrored Model, except using fixed effects instead of market dummies. Models 3 and 4 add the professional ownership/buyer/seller controls for OLSDV and fixed effects respectively.

The two-fold purpose of this process was to first create a high-rent/sales subset by using the residuals from these regressions. Those buildings whose observed rent exceeded their expected rent by certain criteria were considered market premium buildings. Second, using the regression coefficients from the non-green regression, I estimated expected rent and sales from the green dataset.

With this, I was able to generate market premium subsets to compare building attributes, and also residuals from the market premium to compare with the green set.

I ran three sets of comparisons, all shown in Tables 21 and 22. Results are the Kruskal-Wallis test for differences between the two samples for the subject variable (ESTAR, LEED, Dual, Green). First, as a baseline, I compared the green characteristics to the entire non-green data set. As expected, building characteristics from the general population were statistically different than green buildings across the board.

The next two comparisons were designed to specifically test whether premium rent or sales building were similar to green buildings. In the second comparison, I compared the green set to the building with the highest 20%, or the top quintile of residuals from the non-green regression, or the market premium buildings.

Tests of specific building characteristics such as size and age all appeared as unique. As a whole, the premium 20% buildings did not share the same characteristics as the green buildings.

Finally, I created a data set that, rather than top percentage of residuals, included all residuals whose actual rent exceeded expected by 8% or more and sales by 16% or more. Although admittedly somewhat arbitrary, I chose 8% and 16% as the upper bounds of the reasonable findings in the extant literature. Here again, the green and non-green premium sets appear to be statistically different.

Although one model indicated potential similarity, the findings did not indicate that green buildings as a group shared common characteristics with buildings that, for other reasons, generated premium rent in a market.

Table 21: This table presents results from nonparametric tests comparing the attributes of green buildings to three sets of non-green buildings. The first set compared green buildings to all buildings. The second and third sets estimated premiums using different regression models. Model 1 was an OLSDV regression with basic controls, market dummies, and no green variable dummies or ownership/buyer/seller control variables. Model 2 mirrored Model, except using fixed effects instead of market dummies. Models 3 and 4 add the professional ownership/buyer/seller controls for OLSDV and fixed effects respectively. The second set compared green to the non-green buildings whose residuals of expected rent less observed rent were the top 20% of the sample. The third set compared green to the non-green buildings whose residuals of expected rent less observed rent exceeded 8% for rent or 16% for sales. Results are the Kruskal-Wallis test for differences between the two samples for the subject variable. The null is no difference. This table is continued in Table 22. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	Class ESTAR				Class LEED			
Variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model1**	**Model2**	**Model3**	**Model4**
Green to whole non-green data Set								
Lnrent	1336.40***	1336.40***			303.261***	303.261***		
PSF			534.201***	534.201***			56.048***	56.048***
Y_Residuals	3.895**	4.175**	287.544***	70.298***	80.499***	59.739***	40.649***	44.721***
LnSize	4034.25***	4034.25***	1863.64***	1863.64***	336.399***	336.399***	133.034***	133.034***
LnAge	104.960***	104.960***	139.116***	139.116***	480.810***	480.810***	42.924***	42.924***
Stories	2915.69***	2915.69***	1402.37***	1402.37***	242.813***	242.813***	69.638***	69.638***
Green to top 20% of residuals from non-green								
Lnrent	86.161***	590.958***			23.679***	0.388		
PSF			120.353***	285.634***			10.543***	24.157***
Y_Residuals	3449.03***	2994.40***	588.719***	760.973***	127.911***	120.310***	21.401***	25.723***
LnSize	2936.33***	2769.09***	1230.06***	1289.57***	196.963***	181.582***	51.624***	56.565***
LnAge	21.349***	73.882***	59.357***	59.686***	432.720***	449.018***	32.073***	32.536***
Stories	1858.60***	1542.33***	876.492***	914.928***	115.881***	90.606***	18.337***	20.871***
Green to residuals with 8% rent or 16% sales premium from non-green								
Lnrent	96.900***	521.650***			21.138***	0.995		
PSF			3.593*	41.864***			0.330	3.787*
Y_Residuals	3418.60***	2993.05***	289.085***	512.055***	132.511***	120.710***	9.918***	8.650***
LnSize	2794.42***	2849.36***	1419.79***	1499.25***	178.901***	188.211***	71.351***	78.865***
LnAge	25.509***	83.641***	107.346***	72.231***	435.834***	450.588***	37.433***	31.963***
Stories	1747.45***	1617.66***	1063.81***	1178.04***	102.462***	96.388***	33.647***	43.153***
Market Dummies	X		X		X		X	
Fixed Effects		X		X		X		X

Table 22: This table continues Table 21. This table presents results from nonparametric tests comparing the attributes of green buildings to three sets of non-green buildings. The first set compared green buildings to all buildings. The second and third sets estimated premiums using different regression models. Model 1 was an OLSDV regression with basic controls, market dummies, and no green variable dummies or ownership/buyer/seller control variables. Model 2 mirrored Model, except using fixed effects instead of market dummies. Models 3 and 4 add the professional ownership/buyer/seller controls for OLSDV and fixed effects respectively. The second set compared green to the non-green buildings whose residuals of expected rent less observed rent were the top 20% of the sample. The third set compared green to the non-green buildings whose residuals of expected rent less observed rent exceeded 8% for rent or 16% for sales. Results are the Kruskal-Wallis test for differences between the two samples for the subject variable. The null is no difference. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	Class Dual				Class Green			
variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model1**	**Model2**	**Model3**	**Model4**
				Green to whole non-green data Set				
Lnrent	560.097***	560.097***			2233.09***	2233.09***		
PSF			259.162***	259.162***			859.229***	859.229***
Y_Residuals	9.777***	6.939***	182.512***	17.776***	33.106***	8.338***	511.600***	126.284***
LnSize	1458.59***	1458.59***	689.111***	689.111***	5970.94***	5970.94***	2714.75***	2714.75***
LnAge	83.784***	83.784***	67.509***	67.509***	377.769***	377.769***	253.187***	253.187***
Stories	1264.88***	1264.88***	642.587***	642.587***	4497.87***	4497.87***	2101.32***	2101.32***
				Green to top 20% of residuals from non-green				
Lnrent	17.205***	5.409**			21.806***	517.604***		
PSF			0.065	9.565***			116.043***	321.878***
Y_Residuals	657.952***	682.268***	38.460***	160.070***	4772.50***	4304.06***	662.621***	1027.40***
LnSize	1171.83***	1147.48***	533.535***	546.024***	4919.51***	4674.78***	1990.22***	2078.96***
LnAge	40.211***	65.120***	35.819***	35.992***	202.440***	352.756***	139.968***	140.916***
Stories	966.120***	896.841***	472.840***	482.522***	3313.52***	2824.45***	1454.04***	1513.54***
				Green to residuals with 8% rent or 16% sales premium from non-green				
Lnrent	14.480***	3.033*			29.480***	442.403***		
PSF			34.646***	4.696**			22.360***	26.147***
Y_Residuals	632.844***	681.420***	4.446**	110.799***	4857.76***	4309.94***	275.108***	647.740***
LnSize	1126.70***	1158.05***	583.048***	598.236***	4830.89***	4798.94***	2201.84***	2317.35***
LnAge	42.728***	69.033***	53.938***	41.044***	227.872***	377.618***	214.860***	155.060***
Stories	925.649***	912.147***	533.257***	561.156***	3222.88***	2945.52***	1693.36***	1865.38***
Market Dummies	X		X		X		X	
Fixed Effects		X		X		X		X

7.2. Heckman Selection Model

To further examine the question of model endogeneity, I employed Heckman sample selection models. In order to fit two stage model, I had to simplify the parameters from my OLSDV and fixed effect regression models. The use of a lnage variable, rather than categorical age was the most notable change.

I tested the rent data both with, and without the Prof Owner variable in the first stage equation. Results are shown in Tables 23 and 24. I tested four variables for sample selection endogeneity. ESTAR, LEED, and Dual certified buildings were tested independently and also collectively as "Green".

ρ displays the test for sample selection endogeneity, with the null defined as no sample bias. Thus a statistically significant ρ indicated sample bias.

Interestingly, evidence of sample bias changed with the inclusion of the Prof Owner variable. Sample bias did appear in the first test series, Table 23, without Prof Owner. ESTAR and Dual buildings both demonstrated sample selection bias, and only LEED buildings did not. Given my earlier results, and the theoretical basis for missing variables, it was not surprising that the green data set results implied some endogeneity in the extant literature models.

However, when I included the Prof Owner variable in the first stage estimation in Table 24, evidence of green building sample bias disappeared. This finding supported the theoretical inclusion of professional ownership variables in the rent estimations, and supported my argument that prior work may have suffered endogeneity or missing variable issues.

The Sales data was tested with professional ownership variables in Table 25. Several estimations without the professional ownership variables did not converge, and results are not reported. However, even with the ownership related variables in place, the green building sample appeared to have sample bias. Each green building type individually also showed signs of sample bias.

Again, this is not a surprising result. Although, the exact cause of the sample bias is an area for further research, earlier results suggested that Professional Buyers looked to purchase more eco-buildings than non eco-buildings. Increased buyer demand could potentially cause green buildings to be over represented in the sales data relative to the general population.

Table 23: This table presents results from a Heckman two stage test for selection bias. This table test the rent data Each green variable, ESTAR, LEED, and Dual was tested. In addition, green variables as a collective were tested for selection bias. ρ test for selection bias where the null is no bias. Results are the likelihood estimates. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	Lnrent				Green	Estar	Leed	Dual
variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model1b**	**Model2b**	**Model3b**	**Model4b**
ρ					−0.286***	−0.003	0.937***	−0.222
					(−2.801)	(.)	(41.111)	(−1.173)
Intercept	3.353***	2.593	−1.152**	1.874**	−9.555***	−8.432***	−5.311***	−14.325
	(9.806)	(.)	(−2.083)	(2.309)	(−58.267)	(−50.983)	(−13.121)	(−0.183)
lnsize	−0.005	0.017	0.273***	0.111*	0.667***	0.511***	0.333***	0.705***
	(−0.213)	(.)	(6.851)	(1.892)	(48.377)	(36.977)	(10.996)	(27.626)
lnage	−0.073***	−0.021*	−0.429***	−0.016	−0.052***	0.103***	−0.668***	−0.037
	(−7.927)	(−1.658)	(−7.915)	(−0.635)	(−3.627)	(6.503)	(−21.563)	(−1.339)
A Class	−0.076	0.066***	0.570*		1.212***	1.233***	0.827***	4.345
	(−1.045)	(2.869)	(1.902)		(17.497)	(17.651)	(3.090)	(0.056)
B Class	−0.104	−0.028	0.362		0.601***	0.658***	0.469*	3.782
	(−1.627)	(−0.551)	(1.246)		(8.976)	(9.903)	(1.769)	(0.048)
Renovated	−0.122***	−0.074***	−0.122**	−0.036				
	(−5.841)	(−2.829)	(−2.151)	(−0.723)				
Percent Leased	0.002***	0.003***	0.002***	0.002				
	(6.666)	(7.068)	(2.688)	(.)				
stories	0.005***	0.006***	0.001	−0.002				
	(6.100)	(6.103)	(0.359)	(.)				
NNN	−0.226***	−0.256***	−0.109**	−0.233***				
	(−12.715)	(−11.957)	(−2.276)	(−5.929)				
FSG	0.123***	0.136***	0.094**	0.095***				
	(8.947)	(8.827)	(2.238)	(2.668)				
σ	0.336***	0.315***	0.617***	0.350***				
	(38.899)	(70.321)	(9.857)	(22.076)				

Table 24: This table presents results from a Heckman two stage test for selection bias. This table test the rent data Each green variable, ESTAR, LEED, and Dual was tested. In addition, green variables as a collective were tested for selection bias. ρ tests for selection bias where the null is no bias. Results are the likelihood estimates. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	Lnrent				Green	Estar	Leed	Dual
variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model1b**	**Model2b**	**Model3b**	**Model4b**
ρ					0.034	−0.028	0.940***	−0.065
					(0.433)	(−0.375)	(44.363)	(−0.392)
Prof Owner					0.807***	0.793***	−0.074	0.544***
					(34.245)	(31.904)	(−1.528)	(12.102)
Intercept	2.441***	2.658***	−1.197**	1.298*	−8.928***	−7.801***	−5.404***	−15.356***
	(9.983)	(11.940)	(−2.185)	(1.870)	(−51.714)	(−44.502)	(−13.214)	(−71.376)
lnsize	0.052***	0.014	0.275***	0.150***	0.607***	0.442***	0.342***	0.681***
	(3.096)	(0.888)	(6.957)	(2.965)	(41.687)	(30.104)	(11.102)	(25.646)
lnage	−0.076***	−0.022	−0.431***	−0.022	−0.093***	0.089***	−0.664***	−0.060**
	(−8.424)	(−1.616)	(−8.179)	(−0.895)	(−6.098)	(5.228)	(−21.384)	(−2.089)
A Class	0.039	0.056	0.581*		0.981***	1.015***	0.840***	5.394***
	(0.588)	(0.854)	(1.945)		(13.491)	(13.820)	(3.137)	(46.209)
B Class	−0.041	−0.035	0.367		0.483***	0.555***	0.473*	4.925***
	(−0.651)	(−0.566)	(1.270)		(6.869)	(7.963)	(1.786)	(47.035)
Renovated	−0.121***	−0.074***	−0.122**	−0.045				
	(−5.815)	(−2.834)	(−2.164)	(−0.892)				
Percent Leased	0.002***	0.003***	0.002***	0.002**				
	(6.687)	(7.064)	(2.790)	(2.489)				
stories	0.004***	0.006***	0.001	−0.003				
	(5.494)	(6.086)	(0.318)	(−1.452)				
NNN	−0.225***	−0.257***	−0.112**	−0.234***				
	(−12.684)	(−11.958)	(−2.338)	(−5.961)				
FSG	0.125***	0.136***	0.093**	0.097***				
	(9.052)	(8.810)	(2.234)	(2.713)				
σ	0.326***	0.315***	0.622***	0.344***				
	(81.368)	(69.943)	(10.148)	(34.026)				

Table 25: This table presents results from a Heckman two stage test for selection bias. This table test the sales data Each green variable, ESTAR, LEED, and Dual was tested. In addition, green variables as a collective were tested for selection bias. ρ test for selection where the null is no bias. Results are the likelihood estimates. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	Lnrent				Green	Estar	Leed	Dual
variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model1b**	**Model2b**	**Model3b**	**Model4b**
ρ					−0.365***	−0.402***	−0.733***	−0.468**
					(−4.529)	(−4.150)	(−5.440)	(−2.266)
Prof Buyer					0.580***	0.520***	0.045	0.324***
					(11.063)	(9.580)	(0.395)	(4.185)
Prof Seller					0.343***	0.160	0.643***	0.120
					(3.543)	(1.485)	(5.039)	(0.765)
Prof Both					0.857***	0.785***	0.415	−0.107
					(5.141)	(4.890)	(1.558)	(−0.377)
Intercept	876.390***	941.944***	1217.37***	872.025**	−8.445***	−7.963***	−4.349***	−9.552***
	(7.420)	(6.667)	(3.432)	(2.530)	(−38.796)	(−32.616)	(−12.113)	(−23.144)
lnsize	21.594**	14.841	11.015	33.281	0.614***	0.498***	0.234	0.668***
	(2.384)	(1.425)	(0.431)	(1.360)	(30.640)	(22.895)	(.)	(18.432)
lnage	−35.772***	−37.080***	11.081	−32.933***	−0.170***	−0.031	−0.300	−0.208***
	(−7.542)	(−5.420)	(0.544)	(−2.926)	(−7.668)	(−1.202)	(.)	(−5.368)
A Class	−18.413	−19.743	−0.179	−23.065	0.854***	1.074***	0.255*	0.380**
	(−0.673)	(−0.545)	(−0.002)	(−0.423)	(10.610)	(10.782)	(1.814)	(2.399)
B Class	−34.510	−25.639	−42.823	−76.480	0.308***	0.488***	0.195*	−0.001
	(−1.375)	(−0.774)	(−0.662)	(−1.429)	(4.218)	(5.285)	(1.718)	(−0.004)
stories	−2.477***	−1.997***	−1.691	−3.775***				
	(−5.122)	(−3.156)	(−0.692)	(−4.678)				
lnland	−59.309***	−57.013***	−58.430***	−64.011***				
	(−17.390)	(−13.748)	(−4.884)	(−8.773)				
σ	135.610***	130.488***	233.031***	134.140***				
	(33.151)	(23.931)	(5.590)	(9.467)				

7.3. Professional Owner Interactions

To further explore the relationship between Professional Ownership and rent, interaction terms were included in these regressions. In the submarket fixed effects models, both Prof Owner * ESTAR and Prof Owner * Dual were significant and negative. Although at first blush, this may seem counter-intuitive, an examination of the sum of the variables shows that the interaction simply wipes away the significance of the green variable. For example, ESTAR is 0.049 and Prof Owner * ESTAR is -0.045. Together, they offset each other almost completely.

In Table 12 the ESTAR coefficient is not significant. The Prof Owner variable with the interaction is 0.057, and was 0.051 in the prior table.

The interaction terms seem to offset the significance of the green variable, while maintaining the significance of the professional ownership.

Table 26: This table presents a series of fixed effect regressions on lnrent, including professional ownership interaction variables. Models 1-4 used submarket fixed effects. Models 3 and 4 were both weighted by lnsize. Models 5 and 6 used market fixed effects. Models 2, 4, and 6 all include the Prof Owner and interaction variables. Results are the regression coefficient(T-Value). ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

Variable	Model1	Model2	Model3	Model4	Model5	Model6
ESTAR	0.038**	0.049**	0.038**	0.047**	0.038	0.049
	(2.389)	(2.036)	(2.355)	(1.965)	(1.536)	(1.353)
LEED	0.168***	0.152***	0.170***	0.152***	0.168***	0.152***
	(6.248)	(5.467)	(6.160)	(5.368)	(4.618)	(5.000)
Dual	0.031	0.057	0.039	0.066	0.031	0.057
	(1.040)	(1.419)	(1.286)	(1.633)	(0.655)	(1.017)
Prof Owner		0.057***		0.057***		0.057***
		(6.392)		(6.470)		(3.204)
Prof Owner * ESTAR		−0.045**		−0.042**		−0.045*
		(−2.123)		(−2.027)		(−1.711)
Prof Owner * LEED		0.034		0.037		0.034
		(0.854)		(0.917)		(0.819)
Prof Owner * Dual		−0.062*		−0.064*		−0.062*
		(−1.774)		(−1.826)		(−1.781)
Intercept	2.336***	2.393***	2.333***	2.391***	2.336***	2.393***
	(42.396)	(44.983)	(40.819)	(43.526)	(20.503)	(23.117)
lnsize	0.026***	0.020***	0.027***	0.021***	0.026**	0.020*
	(4.425)	(3.501)	(4.408)	(3.512)	(2.239)	(1.886)
age100	−0.015	−0.015	−0.017	−0.018	−0.015	−0.015
	(−0.431)	(−0.436)	(−0.477)	(−0.480)	(−0.195)	(−0.197)
age75	0.034	0.034	0.036	0.036	0.034	0.034
	(0.980)	(0.975)	(1.007)	(1.001)	(0.395)	(0.394)
age50	−0.040	−0.041*	−0.042	−0.043*	−0.040	−0.041
	(−1.619)	(−1.659)	(−1.640)	(−1.679)	(−0.842)	(−0.868)
age40	−0.058***	−0.060***	−0.060***	−0.062***	−0.058*	−0.060*
	(−3.405)	(−3.573)	(−3.420)	(−3.598)	(−1.834)	(−1.925)
age30	−0.120***	−0.123***	−0.123***	−0.127***	−0.120***	−0.123***
	(−9.945)	(−10.246)	(−10.200)	(−10.520)	(−4.759)	(−4.893)
age20	−0.109***	−0.114***	−0.113***	−0.118***	−0.109***	−0.114***
	(−11.055)	(−11.626)	(−11.519)	(−12.116)	(−5.094)	(−5.346)
age15	−0.085***	−0.090***	−0.089***	−0.094***	−0.085***	−0.090***
	(−6.642)	(−7.027)	(−6.943)	(−7.348)	(−4.649)	(−4.862)
age10	−0.108***	−0.113***	−0.113***	−0.119***	−0.108***	−0.113***
	(−9.877)	(−10.427)	(−10.236)	(−10.813)	(−6.475)	(−6.729)
age5	−0.034***	−0.036***	−0.037***	−0.039***	−0.034**	−0.036**
	(−3.753)	(−4.001)	(−4.083)	(−4.365)	(−2.397)	(−2.573)
Renovated	0.019**	0.020***	0.017**	0.018**	0.019*	0.020*
	(2.521)	(2.659)	(2.172)	(2.310)	(1.679)	(1.779)
Percent Leased	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(17.197)	(17.297)	(16.850)	(16.953)	(8.521)	(8.552)
stories	0.009***	0.009***	0.008***	0.008***	0.009**	0.009**
	(4.786)	(4.921)	(4.465)	(4.606)	(2.328)	(2.381)
A Class	0.314***	0.306***	0.316***	0.309***	0.314***	0.306***
	(18.751)	(18.412)	(18.339)	(18.002)	(10.988)	(10.738)
B Class	0.149***	0.148***	0.151***	0.149***	0.149***	0.148***
	(17.138)	(17.020)	(16.528)	(16.416)	(12.007)	(11.953)
NNN	−0.148***	−0.149***	−0.154***	−0.154***	−0.148***	−0.149***
	(−14.401)	(−14.477)	(−14.205)	(−14.287)	(−5.882)	(−5.920)
FSG	0.061***	0.060***	0.060***	0.059***	0.061*	0.060*
	(5.405)	(5.347)	(5.036)	(4.975)	(1.810)	(1.794)
Amenity	0.007	0.006	0.006	0.006	0.007	0.006
	(0.971)	(0.860)	(0.933)	(0.813)	(0.426)	(0.377)
R Square	0.234	0.236	0.243	0.245	0.234	0.236
Denominator DF	1458	1458	1458	1458	55	55
Submarket Fixed Effects	x	x	x	x		
Weighted			x	x		
Market Fixed Effects					x	x

8. Conclusion

This paper was the first to demonstrate that some of the Sustainable Real Estate rent premiums, specifically Energy Star and Dual building premiums, previously shown in the literature were neither theoretically or empirically supported. In addition, I showed the Dual sales premiums may not exist, and the ESTAR sales premiums were significant only at a marginal level.

The theoretical argument against Energy Star building premiums can be summarized as a mismatch in financial motivation. The bulk of ESTAR leases, 61%, were FSG compared to only 14% NNN. In a FSG lease, the tenant receives no benefit from reduced operating expenses. Consequently, they have no incentive to pay a market premium for energy savings that ultimately go to the building owner. Essentially, a commercial broker would be saying to their tenant client, "I know this building cost more to rent, but you're saving the building owner energy costs!"

I presented arguments that the reason for finding of premiums in the extant literature Eichholtz et al. (2010); Fuerst and McAllister (2011); Pivo and Fisher (2010); Wiley et al. (2010) may be attributed to a missing variable problem. Owners who achieve the green certifications may simply be superior owners, and earn premium rents through enhanced negotiating, managing, and building operation skills. The Professional Ownership premium may have been misinterpreted as a green premium. In every regression model, Prof Owner was found to be significant, and in most it dominated the ESTAR premium.

I presented arguments that the use of OLSDV regression with too many dummy variables can potentially lead to inconsistent dummy variable estimations (Baltagi and Kao, 2001). Furthermore, the use of a single linear adjustment to the dependent variable likely fails to adequately capture the market by market complexities of the data. The use of fixed effects and a within transformation of each variable with market fixed effects led to more consistent and reliable building attribute values.

Table 27 summarizes the key finding regarding the rental data. Similar to the extant literature, using OLSDV regression, I found statistically significant ESTAR and Dual premiums. However, using the better suited fixed effects method, the

ESTAR and Dual premiums were no longer statistically significant. The Prof Owner variable remained significant regardless of method.

Table 27: This table summarizes the key results on the rental data from this paper. Models 5 and 6 from Table 12, showing the results from a fixed effect regression with market fixed effects, with and without professional ownership controls are shown. Models 5 and 6 from Table 10, showing the results from OLSDV regression with market dummies, with and without professional ownership controls are shown. Results were the regression coefficient. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	Fixed Effect	Fixed Effect	OLSDV	OLSDV
ESTAR	**0.038**	**0.020**	0.028***	0.021***
LEED	0.168***	0.164***	0.143***	0.141***
DUAL	**0.031**	**0.013**	0.064***	0.056***
Prof Owner		0.051***		0.021***
Market Fixed Effects	X	X		
Market Dummies			X	X

Table 28 summarizes the key finding regarding the sales data. Similar to the extant literature, using OLSDV regression, I found statistically significant ESTAR and Dual premiums. However, using the better suited fixed effects method, and including essential sale condition controls, Dual premiums were no longer statistically significant; the ESTAR premium did maintain a marginal 10% level of significance. The Prof buyer/seller variables remained significant regardless of method.

Further investigating the reasoning behind the different findings of OLSDV and fixed effects, I explored the effect of individual markets. I showed through market by market regression that potential green building premiums may be localized, but no evidence suggesting a national premium was found. In fact, some of the markets even showed negative premiums.

This paper also demonstrated the dramatic effect a couple of markets can have when using OLSDV. By removing just New York City and San Jose from the regression, which did not disproportionately effect the green building N, the ESTAR premiums disappeared with Prof Owner controls. The fact the removal of a mere 2 out of 56 markets alters the statistical significance of the variable of interest raised serious questions as to both the power of the extant findings, and the reliability of OLSDV as an estimation technique for this data set.

Table 28: This table summarizes the key results on the sales data from this paper. Models 1 and 3 from Table 13, showing the results from a fixed effect regression with market fixed effects, with and without professional buyer/seller and sale condition controls are shown. Models 1 and 3 from Table 11, showing the results from OLSDV regression with market dummies, with and without professional buyer/seller and sale condition controls are shown. Results were the regression coefficient. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	Fixed Effect	Fixed Effect	OLSDV	OLSDV
ESTAR	31.24**	**25.56***	39.93***	34.92***
LEED	87.27***	79.25***	80.08***	75.27***
DUAL	**40.63**	**35.33**	70.56***	65.67***
Prof Buyer		44.60***		38.72***
Prof Seller		64.45***		50.59***
Prof Both		86.52**		89.08***
Market Fixed Effects	X	X		
Market Dummies			X	X
Sale Condition Controls		X		X

Through logistic regressions in the rental data, I provided strong evidence for the linkage between professional ownership and rent. The results suggested that ESTAR and Dual buildings were roughly 4.5 times more likely to be Professionally Owned than not. Through logistics regression on the sales data, I demonstrated that professional buyers have an increased appetite for green buildings. Professional buyers were 2 to 3 times more likely to purchase a green buildings, but no correlation was found to sell a green buildings.

Finally, robustness tests in the form of non-parametric and Heckman tests for endogeneity further confirmed the paper's conclusions.

The findings in this paper counter much of the extant literature regarding sustainable real estate premiums. The exploration of alternate estimation techniques such as fixed effects, the inclusion of potentially missing variables like professional ownership, and the detailed exploration of market by market effects represent not only new contributions to the literature, but starting points for continued research.

Several avenues of new research can be explored through the results in this paper. In large, national Commercial Real Estate databases, does the use of fixed effects alter findings in other extant literature? Since this research was confined to office buildings, do similar conclusions hold for other property types? Detailed investigations of the size effect, and how buildings of different scale generate attribute premiums is another potential avenue for future research. Increased attention to the market by market differences, and research on the fundamental supply and demand drivers represents yet another avenue.

Although not primary to the research topics of this paper, the evidence presented in the sale price and logistic regressions on the sale condition controls provided rich avenues for discussion and future research.

As a final note, the evidence presented here is not intended to diminish the potential benefits of green buildings. None of this research or the extant literature suggests that the buildings are less valuable. In fact, the potential benefits of increased productivity or CSR policy compliance still exist. All else equal–including rent–tenants may prefer green buildings. Sales prices for building owners may reflect higher demand or decreased cost structure.

This article does suggest that market premiums continue to be driven by supply and demand metrics. At this point, it does not appear the tenants are willing to *overpay* for green buildings. Perhaps the trend towards building green could eventually force a market discount on non-green buildings. At the moment, the data does not suggest rental premiums for green buildings as a whole.

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Appendix

Table A: This table lists the variables used in this paper, and their corresponding field in the CoStar database.

Variable	**Definition**	**CoStar Field Rent**	**Costar Field Sales**
ESTAR	1 if Building is Energy Star Certified, but not Dual	energy_star	energy_star
LEED	1 if Building is LEED Certified, but not Dual	leed_certified	leed_certified
Dual	1 if Building is both ESTAR and LEED		
lnrent	Natural Log of Average Weighted Building Rent	average_weighted_rent	
PSF	Per Square Foot Sales Price		Sale_price/bldg_sf
lnsize	Natural Log of Size	rentable_building_area	bldg_sf
NNN	1 if lease type = Triple Net	services	
FSG	1 if lease type = Full Service Gross	services	
Percent Leased	Percentage of building leased Q4 2011	percent_leased	
ren_within_10	1 if building was renovated from 2001 forward	year_renovated	
lnland	Natural Log of land		land_area_sf
stories	Number of Stories in Building	number_of_stories	number_of_floors
A_Class	1 if Building is "A" Class	building_class	building_class
B_Class	1 if Building is "B" Class	building_class	building_class
amenity	1 if Building contains any amenities like, Bank, Fitness Center, etc.	Amenities	Amenities
age100	1 if Age >= 100	2011-year_built	2011-year_built
age75	1 if 75>= Age >100	2011-year_built	2011-year_built
age50	1 if 50>= Age >75	2011-year_built	2011-year_built
age40	1 if 40>= Age >40	2011-year_built	2011-year_built
age30	1 if 30>= Age >30	2011-year_built	2011-year_built
age20	1 if 30>= Age >20	2011-year_built	2011-year_built
age15	1 if 15>= Age >15	2011-year_built	2011-year_built
age10	1 if 10>= Age >10	2011-year_built	2011-year_built
age5	1 if 5>= Age	2011-year_built	2011-year_built
year2002	1 If sale occurred during this year		sale_date
year2003	1 If sale occurred during this year		sale_date
year2004	1 If sale occurred during this year		sale_date
year2005	1 If sale occurred during this year		sale_date
year2006	1 If sale occurred during this year		sale_date
year2007	1 If sale occurred during this year		sale_date
year2008	1 If sale occurred during this year		sale_date
year2009	1 If sale occurred during this year		sale_date
year2010	1 If sale occurred during this year		sale_date
year2011	1 If sale occurred during this year	sale_date	
submarket	Submarket for physical building	submarket_cluster	
Market	Market for physical building	market_name	market
Prof Owner	If number of owner addresses meets criteria from Section 5	owner_address	from rent data
Prof Seller	If building seller corresponds to Prof Owner in rent data set		
Prof Buyer	If building buyer corresponds to Prof Owner in rent data set		
Prof Both	If building buyer and seller correspond to Prof Owner in rent data set		

Table B: LEED Federal Regulation **The following legislation or directives have been passed at the federal level**[11]

Agency	Date of passage/ effective date	Description
Department of the Interior	JUN 20, 2008	The Department of the Interior adopted its Sustainable Buildings Implementation Plan, which requires that all new construction and major renovation building projects with gross construction costs greater than $2,000,000 achieve LEED Certified or one Green Globe.
U.S. Department of Energy	FEB 29, 2008	Secretary of Energy Samuel Bodman issued a memorandum to DOE leadership directing heads of departments to adhere to Executive Order 13423, Strengthening Federal Environmental, Energy and Transportation Management (72 FR 3919; Jan. 24, 2007) by building all new Department buildings of $5 million or greater to earn LEED Gold certification.
U.S. Department of Health and Human Services	Nov 7 2007	The Department of Health and Human Services issued a Sustainable Buildings Implementation Plan, requiring new construction or major renovation projects of HHS-owned buildings built with at least $3 million of Federal funds to earn LEED certification, Green Globes certification, or certification by another nationally recognized green building standard.
National Aeronautics and Space Administration	JUN 13, 2006	New construction and major renovations of NASA facilities projects planned for FY 2006 and beyond are required to meet LEED Silver certification, and strive for LEED Gold. FY 2004 and FY 2005 projects will strive to meet LEED Silver certification. All other building projects will strive to follow the LEED rating system as much as possible. The LEED goal for NASA facilities projects will be reviewed, renewed or changed every three years.

[11]Data from http://www.usgbc.org/PublicPolicy/SearchPublicPolicies.aspx?PageID=1776 retrieved 10/2/2011

Smithsonian Institution	NOV 13, 2006	The Smithsonian Institution issued "Smithsonian Directive 422" in response to Executive Order 13123: Greening the Government through Efficient Energy Management. The directive articulates the Smithsonian's goal to design, build, and maintain facilities that are eligible for, and that obtain, LEED certification. Initially, the Smithsonian requires all new buildings and renovation work to aim for a minimum of LEED certification. In addition, the Smithsonian will integrate the LEED checklist and guidelines into the planning, engineering, design, construction, deconstruction, and maintenance of Smithsonian facilities.
U.S. Department of Agriculture	JUN 19, 2006	The U.S. Department of Agriculture issued a Departmental Regulation that requires new construction or major renovation of covered facilities to earn a minimum of LEED Silver certification. The USDA has integrated these requirements, along with strategies for improving energy and water use in existing buildings, into their August 2007 Sustainable Buildings Implementation Plan.
U.S. Environmental Protection Agency	FY 2006	The Environmental Protection Agency requires all its new facility construction and new building acquisition projects 20,000 square feet or larger achieve LEED Gold certification. The Agency currently has multiple projects registered for LEED for New Construction certification and supported the development of LEED for Existing Buildings. The Agency requires GSA to provide new major office leases that meet the Energy Star requirements. EPA's Chelmsford, MA lab is the first Gold-rated federal building.
U.S. Army	n/a	The Army adopted LEED into its Sustainable Project Rating Tool (SPiRiT), but does not require certification of its projects. In January 2006, the Army issued a memorandum stating that it will transition from SPiRiT to LEED beginning in FY 2008. All new vertical construction projects will achieve LEED Silver certification. Additionally, the Army will adopt LEED for Homes when it is released.
U.S. Department of Agriculture	n/a	U.S. Forest Service requires all new construction of office buildings, visitor centers, research facilities, and climate controlled warehouses 2,500 sq ft or greater in size to earn LEED Silver certification. The Forest Service Rocky Mountain Region hosts an annual Sustainable Operations Summit to share lessons and strategies.

U.S. Air Force	n/a	The Air Force has developed a LEED Application Guide for Lodging projects and has conducted LEED training seminars for its design and construction personnel. The Air Force encourages the use of LEED for new or major renovations for MILCON projects and has created an online design guide for sustainable development structured after LEED. An online Sustainable Training course is also being developed.
U.S. General Services Administration	n/a	In order to objectively measure its sustainable design achievements, GSA decided in 2000 that beginning in 2003 all capital building projects must earn LEED Certified, with a target of LEED Silver. In 2008, in response to the changing market, GSA began requiring all lease construction to earn LEED Silver certification.

ESSAY 2

Size Does Matter:

Portfolio weighting and size differentiation in sustainable real estate.

Abstract

This paper demonstrated clear differences in the potential sustainability premiums across different size categories of buildings. This paper provided evidence that the premiums in the extant literature may have been driven by the smaller subset of buildings, and that larger buildings demonstrated neither rent nor sales premiums. This paper also proposed that value weighting real estate portfolio estimations provides important information as to the economic impact of attributes in the hedonic regressions.

1. Introduction

When it comes to sustainable real estate market premiums, size does matter. Most of the prior literature examined sustainable real estate as a uniform body; this research showed that premiums, or the lack thereof, vary with different size categories of buildings. This paper also provided support that a heterogenous relationship exists between size and sales/rent.

Both econometric and economic issues exist when evaluating a diverse set of buildings. From an econometric perspective, sales per square foot (PSF) varies with size. In general, larger buildings tend to sell at larger nominal prices, but lower PSF prices than smaller buildings. The assumption of independence for the independent variables used in most sales regressions, PSF or sale price, may be erroneous.

Economically, the issue of equal weight versus value weight in a real estate portfolio has received little academic attention. Although the bulk of the extant finance literature in stocks, bonds, etc., addresses both equal and value weights. The issues remains unexplored, at least in sustainable real estate. Value weighting matters at its most basic level because an investor can not easily purchase one floor of a twenty story buildings as an equal investment to a smaller building.

This article investigated whether sustainable real estate premiums persisted across all building size categories, or if they were localized to specific sizes. The results indicated that Energy Star rent premiums were localized to smaller buildings. They also suggested that Dual and LEED buildings' economic premiums were driven by the smaller buildings in their data sets as well.

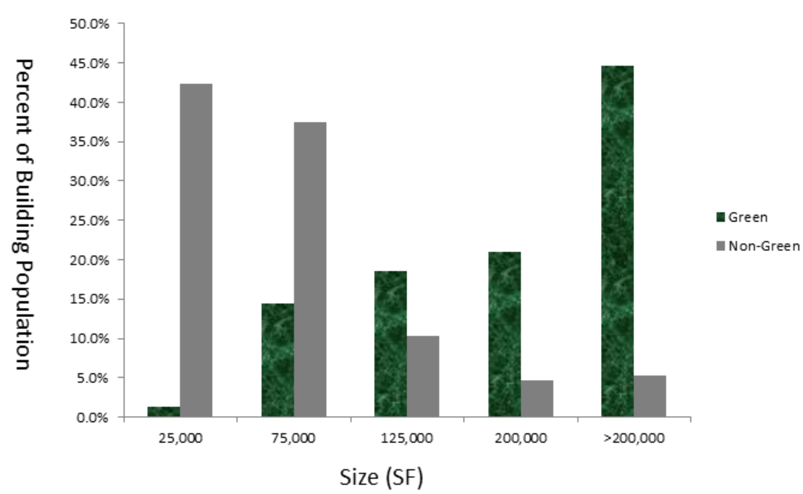
The results lend further support to the management theory put forth by Robinson, 2013. The findings also set a precedent that future research should consider equal weight and value weight analyses.

2. Literature Review

Sustainable real estate typically describes buildings with an Energy Star (ESTAR), Leadership in Energy and Environmental Design (LEED), or both designations.[1] Trends in commercial real estate have driven increased attention of academic researchers; LEED-certified buildings now account for nearly one-third of new construction in the U.S. (Kok, McGraw, and Quigley, 2011). Several articles provided empirical support for sustainable building sales, leasing and cap rate premium. Notable examples include Eichholtz, Kok, and Quigley (2010); Fuerst and McAllister (2011); Miller, Spivey, and Florance (2008); Pivo and Fisher (2010); Wiley, Benefield, and Johnson (2010) all of whom found support for market premiums.

Sustainable buildings tend to be larger than average size buildings. Figure 1 shows the percentage of the building population for Green, or sustainable buildings, versus the general population.

Figure 1: Green Building and Traditional Building Size Distributions. Source: CoStar Group Q4 2011



The graph shows that nearly 80% of the non-eco building sample is 75,000 SF

[1] See section 3 for detailed descriptions of Energy Star and LEED

or smaller. By contrast, 84% of the green building population measures larger than 75,000 SF.

A brief analysis of the means and standard deviations reveals the discrepancy again. Table 1 shows that the eco-buildings as whole are notably larger. The subject rent sample contains all buildings in a market greater than 10,000 Square Feet (SF). The Eco building population had a mean size of 264,398 SF and standard deviation of 276,175 SF, compared to a mean of 56,239 SF and standard deviation of 88,819 SF for the non-green sample. The sales sample showed a similar discrepancy with means of 55,071 SF and 320,323 SF for the general population and Eco buildings, and standard deviations of 107,156 SF and 314,712 SF respectively.

Table 1: Mean and Standard Deviations for the general building population and eco-building population. Eco buildings are ESTAR, LEED, or Dual. The general building population included all buildings over 10,000 SF.

	Rent		Sales	
	Mean	Std Dev	Mean	Std Dev
Building Population	56,239	88,819	55,071	314,712
Eco-Buildings	264,398	276,175	320,323	107,156

The bulk of the current published research on sustainability premiums treats the portfolio of green real estate effectively as an equal weight portfolio (Eichholtz et al., 2010; Fuerst and McAllister, 2011; Pivo and Fisher, 2010; Wiley et al., 2010). In other words, each observation represents an equal weight in the regressions. Potential economic issues, such as such as ignoring investment size, and econometric issues, such as introducing additional heteroscedasticity, arise from the exclusive use of equal weighting. The idea of segmenting real estate regressions by size has also been seen in the literature (Simons and El Jaouhari, 2004).

In an economic sense, real estate assets are investment assets like any other financial investment. An investor attempts to generate returns whether they purchase stocks, bonds, or real estate assets. The predominant research method in the extant investment literature for stock and bond portfolios involves examining both an equal weight and a value weighted portfolio. Real estate assets should be treated no differently. Most real estate portfolios do not hold equal funds in each property, and the bulk of funds are heavily skewed towards larger properties (Schuck and Brown, 1997).

It is well known in the finance investment literature that equal-weight returns produce different results than value-weight returns (Brown and Warner, 1980; Fama, 1998; Fama and French, 1988). The practice of giving every observation equal weight suggests that an investor would generate the same effective return by purchasing five \$200,000 real estate assets as they would by purchasing one \$1,000,000 real estate asset, holding portfolio diversification effects constant.

From an investment perspective, value weighting more realistically imitates an investor experience for real estate valuation estimations. In the stock market, investors could choose to allocate funds in any combination between a stock with a large stock market capitalization (large cap) and one with a small stock market capitalization (small cap). In selecting a real estate asset, investors must choose to purchase one asset over another. Investors just cannot choose to buy one share of a 500,000 SF building in the same way they might buy one share of a large cap stock.[2] Therefore, the relative effect of large buildings on the portfolio of an equal weighted estimation systematically biases the achievable market returns relative to a value weighted measure. In the end, the existence of rental or sales premiums matters for potential investment opportunities.

Also, from an econometric perspective, the existing literature appears to overlook the size of buildings as an issue other than as a control variable. The basic assumption of independence does not truly hold for either rent or sales prices and size. Rent tends to increase with larger buildings for a variety of reasons including view premiums,

[2]The author recognize that the existence of Tenant-in-Common (TIC), and Real Estate Investment Trusts (REIT) do permit some buyers to purchase limited shares of real estate assets. However, REITs provide indirect ownership of real estate through equity holdings, while the direct investment in real estate assets is managed through fiduciary responsibility obligations as individual investments in the portfolio. Tenant-In-Common Association (TICA) recently changed their name to Real Estate Investment Securities Association (REISA), and there currently exists debate whether TICs are direct or indirect real estate investment. Furthermore, TIC investments represent a comparatively small portion of the market.

amenities, and the tendency for vertical buildings to be located in premium areas. Also, price per square foot tends to decrease with size. Smaller buildings, on average, have lower PSF prices than larger buildings.

Furthermore, as shown in Figure 1, the ESTAR population is not uniformly distributed along the building population size distribution. Weighting is a common method to reduce issues of heteroscedasticity.

For the sales data, the weighted regressions use nominal price as the weight. Since the rental data set does not include price, size was proxied as value for the weighting variable. Although not a perfect proxy for price due to the non-linear relationship between size and price, it represents a reasonable value weight for the portfolio. This more heavily weights the larger, and more costly assets in the regression, in a similar manner to how they would be weighted in an economic investment portfolio.

3. Data

The primary data source for my analysis was sales and rental observations from CoStar.[3] CoStar contains over 2.8 Million US Commercial properties, including sales and leasing information. Data includes, but is not limited to location, physical buildings characteristics, tenants, and lease details. My sample was from Q4 2011 for the rent data, and 2001 to 2011 for the sales data. Key variables include those typical found in a real estate regression, such as Size, Age, Building Class (A,B,C), Market, and Rent or PSF as the independent variable. A detailed list of variables used in this research can be found in the Appendix, Table A.

Descriptive Statistics

The rent data was cleaned to include only data with a size and rent fields existing, and the sales data cleaned to only include data with sale price and size fields in place. The data consists of 48,733 rent observations across 56 defined markets drawn from the top 50 Metropolitan Statistical Areas (MSA) in the United States; all rent observations are from Q4 2011. The sales data covers from 2001 to 2011, also in the

[3] Source: CoStar Group, Inc.

top 50 MSA's (56 defined markets) in the United States. The sales data has 26,248 observations.

Table 2 summarizes the rent data size and rent by eco-building type. Clear differences in the mean size mean and rent are observed between non-Eco and Eco-labeled buildings.

Table 3 summarizes the sales data by green building type. As with rent, clear differences are observed in both Per Square Foot (PSF) sales price and size between non-Eco and Eco buildings.

Several extremely small minimum PSF prices observed in the data were verified as reasonable. There are approximately 20 sales under $1.00 PSF. All but one occur during the financial crisis period, and several are noted as auction or distress sales, which is controlled for in several of the regression specifications. Even though portfolio sales were explicitly exempted from the sales sample, several sales of over $1 Billion dollars were removed, and assumed to be part of a portfolio sale.

Table 2: Rental Descriptive Statistics. The following table provides descriptive statistics for the rental data set. The rental data set was from Q4 2011, and including the all office buildings over 10,000 SF from the top 50 MSA by population. Source: CoStar Group, Inc.

	Size					**Rent**			
	n	**mean**	**std**	**max**	**min**	**mean**	**std**	**max**	**min**
No Eco-Label	45,354	56,239	88,819	3,781,045	10,000	18.62	10.23	600	0.95
All Eco	3,379	264,398	276,175	4,000,000	10,000	25.48	12.73	253.55	5.46
ESTAR Certified	2,473	228,464	233,246	2,650,000	10,000	24.56	11.0093	250	5.46
LEED Certified	278	223,761	331,746	4,000,000	10,524	28.55	16.7803	253.55	6.48
Dual Certified	628	423,892	341,333	1,721,242	33,851	27.72	16.0813	250	8.50

Table 3: Sales Descriptive Statistics. The following table provides descriptive statistics for the sales data set. The sales data set was from 2001 through 2011, and included all office buildings sales over 10,000 SF from the top 50 MSA by population. Source: CoStar Group, Inc

The small minimum PSF prices were verified. There are approximately 20 sales under $1.00 PSF.

All but one occur during the financial crisis period, and several are noted as auction or distress sales.

	PSF					Size			
eco	**n**	**mean**	**std**	**max**	**min**	**mean**	**std**	**max**	**min**
No Eco-Label	24,875	140	130	3,888	0.0002	55,071	107,156	4,400,000	10,000
All Eco Buildings	1,382	231	145	914	1.85	320,323	314,712	2,958,981	10,000
Energy Star Certified	933	223	138	914	11.71	295,062	288,209	2,650,000	10,172
LEED Certified	158	247	197	901	3.99	205,873	300,399	2,550,000	10,000
Dual Certified	295	257	145	830	1.85	481,173	384,689	2,958,981	11,785

Energy Star for Buildings

The U.S. Environmental Protection Agency and the U.S. Department of Energy jointly manage the Energy Star program. Energy Star is available for 13 types of commercial buildings, including retail stores, hotels, schools, and supermarkets. Nearly 9,000 buildings across the nation have earned the Energy Star for superior energy efficiency over the past decade and the numbers continue to climb daily. Energy Star buildings typically use 35 percent less energy and emit 35 percent less carbon dioxide into the atmosphere than average buildings (U.S. Environmental Protection Agency, 2009).

Under the program, the energy performance of a building is scored on a 1-100 scale; buildings scored 75 or above are recognized as Energy Star Certified Buildings. The numbers directly relate to percentage ratings. For example, a building that has a score of 80 means the building is in the top 20% of facilities in the country for energy performance. The score is calculated by estimating how much energy the building would use if it were the best- or worst-performing building of its type (along with levels in between) in terms of its size, location, and number of occupants. The rating system then compares the actual energy data input to the internal database to determine where the building ranks relative to other similar buildings (Ciochetti and McGowan, 2010).

Leadership in Energy and Environmental Design (LEED)

The U.S. Green Building Council (USGBC) operates the LEED Green Building Rating System as an independent third party. They are a non-profit organization with a stated mission, "To transform the way buildings and communities are designed, built and operated, enabling an environmentally and socially responsible, healthy, and prosperous environment that improves the quality of life."

LEED promotes a whole-building approach to sustainability by examining five categories of building performance:

1. sustainable site development,

2. water efficiency,
3. energy efficiency,
4. materials selection,
5. and indoor environmental quality (U.S. Green Building Council, 2009).

Building owners earn points in each of the five categories, with allocation of points between credits based on the potential environmental impacts and human benefits of each credit with respect to a set of impact categories. In addition, properties can earn credit for regionally specific innovations that may relate to climate, transportation, or other related issues. Depending on the number of total points earned, buildings can achieve LEED levels of certified, silver, gold or platinum.

The certified level indicates conformance with minimum requirements for LEED certification, and the platinum certification level indicates outstanding levels in virtually all categories.

4. Research Methods

To investigate the impact of size, I divided the data into thirds using two different methods. First, I divided evenly by the Energy Star distribution. Since ESTAR contains the highest percentage of eco buildings, it seemed the most logical choice.

When the data was evenly divided by the ESTAR distribution, the heavy skew towards larger building was evidenced by the building populations. Buildings in the smallest third of ESTAR sizes numbered 41,360, or 85% of the buildings. The largest third of ESTAR buildings compared in size to only 2,825 of the general building population, or under 6% of all buildings greater than 10,000 SF. Also, in the largest category, with buildings over 224,555 SF, nearly half were green certified in some way. Similarly, nearly half the sales in the largest category were green certified.

The second method of grouping was to evenly divide the population into thirds by population buildings size. Dividing the data into three evenly distributed subsections by size showed a skewed distribution of green buildings. The large majority of green buildings appeared in the largest section. 2,257 of the ESTAR buildings were in the largest third compared to only 30 in the smallest third. Similarly the Dual certified buildings were skewed 621 in the largest third to zero in the smallest.

Table 4: This table shows the distribution of green buildings types and professional ownership controls for the two size sectioning methods. The ESTAR method divides the ESTAR population into even thirds, and allows the building population to fit into their respective size categories. The by size method divides the building population of all buildings greater than 10,000 SF into even thirds, and the green buildings fit into their respective size categories. Some buildings at the segment break points were equal, and caused the sections to be off by one or two buildings from exactly thirds.

			Rent			
	ESTAR by Thirds			Size by Thirds		
	<112,816 SF	<Middle>	> 224,555 SF	< 21,212 SF	<Middle>	> 53,758 SF
ESTAR	825	824	824	30	186	2,257
LEED	114	82	82	11	38	229
Dual	68	147	413	0	7	621
Non-Eco	40,353	3,495	1,506	16,203	16,014	13,137
Building N	41,360	4,548	2,825	16,244	16,245	16,244
Prof Owner	4,887	1,964	1,473	568	1,872	5,884
			Sales			
	ESTAR by Thirds			Size by Thirds		
	<151,775 SF	<Middle>	> 280,563 SF	<17,435 SF	<Middle>	> 44,019 SF
ESTAR	311	310	312	10	24	899
LEED	93	35	30	14	26	118
Dual	32	71	192	5	4	286
Non-Eco	23,093	1,122	660	8,724	8,709	7,442
Building N	23,529	1,538	1,194	8,753	8,763	8,745
Prof Seller	180	55	51	15	45	226
Prof Buyer	434	211	204	18	60	771
Prof Both	23	21	23	0	1	66

Fixed Effect Regression

The rent and sales models are of a standard one stage semi-log hedonic regression form:

$$ln(R_{jt}) = \alpha_j + \beta_j X_i + \phi_j Z_i + \varepsilon_j \tag{1}$$

$$PSF_{jt} = \alpha_j + \beta_j X_i + \phi_j Z_i + \varepsilon_j \tag{2}$$

where:

$\ln(R_{jt})$	= natural log of average rent per square foot in a given building j
(PSF_{jt})	= sales price per square foot in a given building j
X_i	= a vector of the property specific explanatory variables
β_i	= the regression-derived coefficient for property characteristic i
Z_i	=a vector of time and non-property variables
ϕ_i	= the regression-derived coefficient for time and non-property variable i
ε_j	= random error term
j, t	= property and time variables respectively

Fixed effects by market were included each regression; this method was shown to be a better estimation technique for national commercial real estate (CRE) by Robinson, 2013.[4] Fixed effects transform the variables prior to the regression by altering them based on the mean of the specific market.

A detailed list of the variables used, along with their corresponding fields in the CoStar database can be found in the Appendix, Table A.

Weighted Regressions

As discussed earlier, both economic and econometric issues arise from assuming the independence of size. A simple transformation of the basic hedonic regressions from equations 1 and 2 allowed re-estimation of the original equations with value weights.

The sales data contained price information, and price was used as the weight. Since the rent data did contain price information, the weighting for the rent data was by its size. Although size does not represent a perfect proxy for price, it does act as a reasonable proxy.

Define:

$$\text{Size}_{total} = \sum_{j}^{N} \text{Size}_j \tag{3}$$

where Size_j = the size for property j, and

[4]Standard ordinary least squares regression results are available upon request.

$$w_j = \frac{\text{Size}_j}{\text{Size}_{total}} \tag{4}$$

In other words w_j represents the size weight of the building in the portfolio of buildings being estimated. The formula definitions are the same as above:

$$ln(R_{jt}) = (\alpha_j + beta_j X_i + \phi_j Z_i + \varepsilon_j) * w_j \tag{5}$$

$$ln(PSF_{jt}) = (\alpha_j + beta_j X_i + \phi_j Z_i + \varepsilon_j) * w_j \tag{6}$$

Professional Management Variables

Robinson, 2013 introduced the Professional ownership variable, and demonstrated its significance in estimating sustainability premiums. He found that professional management added 5.1% to rent, and that professional sellers added $67 PSF to a sales price; both variables were significant at the 1% level. The question the variable addresses is whether in green real estate, eco-labeling itself created a premium, or if developers/managers of newer, well located buildings, that tended to capture ceterus paribus rent premiums, enhance their offerings with LEED or Energy Star certifications?

Following Robinson, 2013, I addressed the issue of management through a professional ownership dummy variable. This helped assess whether the developers and managers who own and operate these buildings exhibited superior site selection, construction or management, or if the presence of green certification in and of itself created a market premium.

Prof Owner: The Prof Owner, professional ownership variable, used in the rent regressions is a binary dummy variable equal to 1 when an ownership group, as listed by their address in CoStar,[5] owned 6 or more physical properties totalling greater than 500,000 SF. Thus a group that owned 10 small buildings would not qualify via the SF hurdle. Furthermore, a group that owned one or two large buildings would not qualify via the number of properties hurdle.

[5] 5,884 observations had no address field, and were set to zero

These measures are intended to capture ownership groups whose total holdings qualify them as professional owners. The number and scale of commercial property holdings would require, at a minimum, several full time staff members to effectively operate and manage. The dummy variable is set to zero otherwise. While some of the non-Prof Owners may in fact be better owner operators than some of the Prof Owners, the dummy variable's purpose is test for statistical significance of professional ownership at a macro level.

8,327 observations, owned by a total of 435 ownership groups qualified as professionally owned. Professionally owned buildings represented 17% of the building population.

However, professional owned buildings represented a considerably larger portion of green buildings., 70% of Energy Star population, 62% of the LEED population, and 74% of the Dual population were professionally owned..

Prof Seller: A Professional Seller variable was set to one when the seller of a property correlated to the rent database as a Professional Owner. It was set to zero otherwise. One potential hazard with this method is that ownership groups may or may not have qualified at the time of sale. The rent database available covers only Q4 2011, while the sales data covers ten years. Using the rent database to correlate professional ownership uses owners who qualify as of Q4 2011, and who may or may not have qualified at the time of sale. Additionally, some building owners who may have qualified as professional at the time of sale, might no longer be so in Q4 2011. However, I believe the noise around the estimate should be minimal.

Prof Buyer: A Professional Buyer variable was set to one when the seller of a property correlated to the rent database as a Professional Owner. It was set to zero otherwise. As with Professional Sellers, there may be some omitted or erroneously added observations due to time lag.

Prof Both: A Professional Both variable was set to one when both the buyer and seller were categorized as professional

5. Results

Table 5 shows results from regressions with market fixed effects, sorted into equal thirds by the ESTAR distribution. In other words, the number of Energy Star buildings was equally divided among the three samples, but the building distribution could vary. Table 6 similarly shows results from regression with market fixed effects, but divided into equal sections by the size of the building population. In other words, the building population were evenly divided by size, while the green population varied.[6]

[6]The populations are not exactly equal due to some overlap in the size of buildings.

Table 5: This table presents results from fixed effect regressions by market on lnrent of the building population split into thirds by the size of Energy Star (ESTAR) buildings. The smallest third contains the smallest third of the Energy Star buildings, and all buildings under 125,000 SF. In this regressions the ESTAR N is uniformly distributed, but the building population is skewed. In each size category, results are presented first with and without the Prof Owner variable. Next results are presented with the same regression weighted by lnsize, both with and without the Prof Owner variable.***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	Smallest 1/3 ESTAR Buildings (<112,816 SF)				**Mid 1/3 ESTAR Buildings**				**Largest 1/3 (>224,555 SF)**			
Variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**	**Model10**	**Model11**	**Model12**
ESTAR	0.042**	0.062***	0.052**	0.073***	0.014	0.028	0.014	0.028	0.022	0.038	0.041	0.060*
	(2.248)	(3.644)	(2.653)	(4.168)	(0.749)	(1.418)	(0.728)	(1.449)	(0.510)	(0.925)	(1.096)	(1.676)
LEED	0.137***	0.140***	0.145***	0.147***	0.160***	0.165***	0.166***	0.171***	0.112	0.128*	0.151***	0.162***
	(4.545)	(4.561)	(4.944)	(5.046)	(3.924)	(3.888)	(3.980)	(3.942)	(1.509)	(1.797)	(2.930)	(3.239)
Dual	0.014	0.029	−0.005	0.012	0.069	0.087*	0.064	0.083*	0.086	0.107**	0.100*	0.124**
	(0.339)	(0.680)	(−0.099)	(0.255)	(1.358)	(1.835)	(1.273)	(1.785)	(1.592)	(2.090)	(1.815)	(2.432)
Prof Owner	0.049***		0.050***		0.051**		0.053**		0.074***		0.081***	
	(3.700)		(3.605)		(2.588)		(2.616)		(2.928)		(2.717)	
Intercept	2.660***	2.602***	2.536***	2.485***	3.093***	3.068***	3.058***	3.033***	2.131***	2.137***	2.375***	2.386***
	(26.419)	(25.482)	(28.424)	(27.255)	(5.930)	(5.882)	(5.834)	(5.780)	(8.959)	(9.168)	(9.652)	(9.901)
lnsize	−0.007	−0.001	0.001	0.006	−0.032	−0.030	−0.031	−0.028	0.040**	0.040**	0.018	0.018
	(−0.632)	(−0.081)	(0.112)	(0.670)	(−0.753)	(−0.691)	(−0.714)	(−0.651)	(2.119)	(2.120)	(0.863)	(0.864)
age100	−0.108	−0.107	−0.074	−0.074	−0.055	−0.054	−0.048	−0.046	−0.199	−0.206	−0.208	−0.216
	(−1.593)	(−1.573)	(−1.224)	(−1.206)	(−0.373)	(−0.362)	(−0.333)	(−0.322)	(−1.356)	(−1.409)	(−1.489)	(−1.559)
age75	−0.099*	−0.098*	−0.056	−0.055	−0.032	−0.029	−0.010	−0.007	0.001	−0.001	0.011	0.009
	(−1.764)	(−1.736)	(−1.001)	(−0.983)	(−0.310)	(−0.279)	(−0.091)	(−0.061)	(0.007)	(−0.009)	(0.082)	(0.064)
age50	−0.078	−0.077	−0.054	−0.052	−0.136**	−0.133**	−0.118**	−0.115**	−0.054	−0.061	−0.080	−0.090
	(−1.609)	(−1.565)	(−1.044)	(−1.015)	(−2.359)	(−2.345)	(−2.181)	(−2.152)	(−0.377)	(−0.419)	(−0.571)	(−0.633)
age40	−0.109***	−0.107***	−0.074**	−0.072**	−0.107**	−0.101**	−0.088**	−0.082*	−0.140	−0.137	−0.167**	−0.164**
	(−2.952)	(−2.859)	(−2.372)	(−2.304)	(−2.561)	(−2.321)	(−2.142)	(−1.911)	(−1.524)	(−1.472)	(−2.490)	(−2.363)
age30	−0.156***	−0.152***	−0.120***	−0.117***	−0.144***	−0.136***	−0.133***	−0.124***	−0.270***	−0.265***	−0.248***	−0.244***
	(−5.699)	(−5.562)	(−4.665)	(−4.554)	(−3.955)	(−3.784)	(−3.648)	(−3.449)	(−5.817)	(−5.767)	(−6.344)	(−6.295)
age20	−0.131***	−0.125***	−0.102***	−0.097***	−0.167***	−0.155***	−0.152***	−0.141***	−0.309***	−0.304***	−0.283***	−0.276***
	(−5.919)	(−5.591)	(−4.582)	(−4.342)	(−5.306)	(−5.067)	(−4.922)	(−4.625)	(−7.213)	(−7.163)	(−7.546)	(−7.569)
age15	−0.091***	−0.085***	−0.072***	−0.067***	−0.103***	−0.096***	−0.099***	−0.091***	−0.351***	−0.343***	−0.318***	−0.309***
	(−4.251)	(−3.962)	(−3.649)	(−3.427)	(−3.812)	(−3.407)	(−3.726)	(−3.301)	(−7.410)	(−7.156)	(−8.034)	(−7.820)
R Square	0.222	0.220	0.194	0.192	0.227	0.223	0.229	0.224	0.237	0.231	0.234	0.227
Model N	41,266	41,266	41,266	41,266	4,542	4,542	4,542	4,542	2,822	2,822	2,822	2,822
ESTAR-N	825	825	825	825	824	824	824	824	824	824	824	824
LEED-N	114	114	114	114	82	82	82	82	82	82	82	82
Dual-N	68	68	68	68	147	147	147	147	413	413	413	413
Non-Eco-N	40,353	40,353	40,353	40,353	3,577	3,577	3,577	3,577	1,506	1,506	1,506	
Prof Owner	4,887	4,887	4,887	4,887	1,964	1,964	1,964	1,964	1,473	1,473	1,473	1473
Weighting			X	X			X	X			X	X
Market Fixed Effects	X	X	X	X	X	X	X	X	X	X	X	X

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Variable	Smallest 1/3 ESTAR Buildings (<112,816 SF)				Mid 1/3 ESTAR Buildings				Largest 1/3 (>224,555 SF)			
	Model1	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**	**Model10**	**Model11**	**Model12**
age10	−0.125***	−0.118***	−0.093***	−0.088***	−0.186***	−0.174***	−0.176***	−0.164***	−0.298***	−0.297***	−0.266***	−0.265***
	(−7.045)	(−6.531)	(−5.634)	(−5.287)	(−5.582)	(−5.314)	(−5.382)	(−5.098)	(−5.092)	(−5.147)	(−6.582)	(−6.664)
age5	−0.055***	−0.053***	−0.028*	−0.027*	−0.068**	−0.056*	−0.063*	−0.051	−0.091*	−0.088	−0.104**	−0.100**
	(−3.670)	(−3.479)	(−1.946)	(−1.849)	(−2.120)	(−1.765)	(−1.977)	(−1.602)	(−1.683)	(−1.662)	(−2.278)	(−2.219)
Renovated	0.024*	0.022*	0.032**	0.030**	0.033**	0.030**	0.024*	0.021	−0.071*	−0.070*	−0.054*	−0.052
	(1.934)	(1.769)	(2.627)	(2.496)	(2.252)	(2.084)	(1.681)	(1.499)	(−1.791)	(−1.797)	(−1.693)	(−1.624)
Percent Leased	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.005***	0.005***	0.004***	0.004***
	(8.886)	(8.841)	(9.495)	(9.456)	(4.499)	(4.502)	(4.647)	(4.651)	(3.922)	(3.817)	(4.368)	(4.252)
stories	0.032***	0.032***	0.036***	0.036***	0.017***	0.017***	0.018***	0.018***	0.001	0.001	0.002	0.002
	(4.372)	(4.292)	(4.815)	(4.735)	(3.574)	(3.547)	(3.478)	(3.451)	(0.426)	(0.400)	(0.606)	(0.566)
A Class	0.298***	0.304***	0.290***	0.296***	0.280***	0.286***	0.294***	0.300***	0.400***	0.412***	0.402***	0.415***
	(8.603)	(8.839)	(10.508)	(10.817)	(6.612)	(6.675)	(6.976)	(7.044)	(6.232)	(6.406)	(6.170)	(6.165)
B Class	0.145***	0.147***	0.140***	0.141***	0.107***	0.108***	0.119***	0.120***	0.179**	0.184**	0.209***	0.212***
	(7.813)	(7.900)	(10.278)	(10.345)	(2.949)	(2.937)	(3.323)	(3.298)	(2.550)	(2.578)	(2.727)	(2.686)
NNN	−0.163***	−0.163***	−0.131***	−0.131***	−0.219***	−0.219***	−0.217***	−0.217***	−0.305**	−0.300**	−0.286***	−0.282***
	(−6.726)	(−6.643)	(−6.744)	(−6.674)	(−4.155)	(−4.163)	(−4.216)	(−4.219)	(−2.652)	(−2.610)	(−2.856)	(−2.814)
FSG	0.046	0.047	0.053**	0.053**	0.054	0.056	0.052	0.054	0.003	0.005	0.031	0.034
	(1.395)	(1.412)	(2.059)	(2.071)	(0.755)	(0.777)	(0.743)	(0.765)	(0.025)	(0.044)	(0.288)	(0.308)
Amenity	−0.003	−0.002	0.001	0.001	−0.035	−0.033	−0.038	−0.036	0.011	0.021	0.010	0.020
	(−0.172)	(−0.142)	(0.065)	(0.095)	(−1.387)	(−1.307)	(−1.555)	(−1.489)	(0.248)	(0.448)	(0.229)	(0.436)
R Square	0.222	0.220	0.194	0.192	0.227	0.223	0.229	0.224	0.237	0.231	0.234	0.227
Model N	41,266	41,266	41,266	41,266	4,542	4,542	4,542	4,542	2,822	2,822	2,822	2,822
ESTAR-N	825	825	825	825	824	824	824	824	824	824	824	824
LEED-N	114	114	114	114	82	82	82	82	82	82	82	82
Dual-N	68	68	68	68	147	147	147	147	413	413	413	413
Non-Eco-N	40,353	40,353	40,353	40,353	3,577	3,577	3,577	3,577	1,506	1,506	1,506	
Prof Owner	4,887	4,887	4,887	4,887	1,964	1,964	1,964	1,964	1,473	1,473	1,473	1473
Weighting			X	X			X	X			X	X
Market Fixed Effects	X	X	X	X	X	X	X	X	X	X	X	X

Table 6: This table presents results from fixed effect regressions by market on lnrent of the building population split into thirds by size. In each size category, results are presented first with and without the Prof Owner variable. Next results are presented with the same regression weighted by lnsize, both with and without the Prof Owner variable. The "N" for each sustainable real estate building type is listed at the bottom of the table. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	Smallest 1/3 Buildings > 21,212 SF				**Mid 1/3 Buildings**				**Largest 1/3 Buildings > 53,758 SF**			
Variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**	**Model10**	**Model11**	**Model12**
ESTAR	0.300**	0.318**	0.301**	0.319**	0.099***	0.130***	0.099***	0.130***	0.030	0.048**	0.030	0.047**
	(2.245)	(2.494)	(2.238)	(2.487)	(3.441)	(4.799)	(3.499)	(4.905)	(1.653)	(2.458)	(1.584)	(2.366)
LEED	0.069	0.072	0.070	0.073	0.126**	0.128**	0.123**	0.126**	0.151***	0.157***	0.151***	0.158***
	(0.924)	(0.978)	(0.936)	(0.994)	(2.099)	(2.164)	(2.066)	(2.131)	(4.233)	(4.184)	(4.226)	(4.190)
Dual	0.000	0.000	0.000	0.000	0.004	0.010	0.006	0.013	0.061	0.079**	0.063	0.082**
	(.)	(.)	(.)	(.)	(0.031)	(0.088)	(0.054)	(0.115)	(1.583)	(2.185)	(1.612)	(2.206)
Prof Owner	0.046**		0.046**		0.057***		0.058***		0.056***		0.056***	
	(2.417)		(2.440)		(3.029)		(3.030)		(3.158)		(3.126)	
Intercept	2.240***	2.228***	2.242***	2.230***	2.516***	2.429***	2.514***	2.427***	2.785***	2.731***	2.747***	2.694***
	(13.436)	(13.329)	(13.464)	(13.356)	(16.827)	(16.288)	(16.755)	(16.196)	(7.755)	(7.370)	(7.695)	(7.313)
lnsize	0.022	0.023	0.021	0.023	0.003	0.011	0.003	0.011	−0.007	−0.002	−0.004	0.001
	(1.235)	(1.310)	(1.227)	(1.304)	(0.168)	(0.736)	(0.180)	(0.750)	(−0.253)	(−0.079)	(−0.138)	(0.029)
age100	−0.066	−0.065	−0.067	−0.066	−0.117*	−0.115*	−0.117*	−0.115*	−0.086	−0.085	−0.085	−0.084
	(−1.541)	(−1.521)	(−1.570)	(−1.548)	(−1.729)	(−1.691)	(−1.731)	(−1.693)	(−0.791)	(−0.783)	(−0.772)	(−0.764)
age75	0.012	0.012	0.012	0.013	−0.100**	−0.098**	−0.102**	−0.099**	−0.007	−0.005	−0.002	−0.000
	(0.196)	(0.207)	(0.203)	(0.214)	(−2.136)	(−2.079)	(−2.172)	(−2.116)	(−0.072)	(−0.050)	(−0.023)	(−0.003)
age50	−0.022	−0.021	−0.022	−0.022	−0.082	−0.080	−0.082	−0.080	−0.085	−0.084	−0.082	−0.081
	(−0.397)	(−0.385)	(−0.401)	(−0.388)	(−1.544)	(−1.505)	(−1.549)	(−1.510)	(−1.478)	(−1.454)	(−1.354)	(−1.334)
age40	−0.038	−0.038	−0.039	−0.038	−0.093***	−0.089**	−0.094***	−0.090***	−0.119***	−0.115**	−0.118***	−0.114**
	(−1.261)	(−1.241)	(−1.270)	(−1.250)	(−2.795)	(−2.663)	(−2.820)	(−2.687)	(−2.682)	(−2.511)	(−2.686)	(−2.508)
age30	−0.076***	−0.075***	−0.076***	−0.075***	−0.133***	−0.128***	−0.134***	−0.129***	−0.197***	−0.191***	−0.197***	−0.191***
	(−2.739)	(−2.687)	(−2.758)	(−2.704)	(−4.939)	(−4.747)	(−4.977)	(−4.782)	(−6.303)	(−6.032)	(−6.358)	(−6.081)
age20	−0.077***	−0.075***	−0.077***	−0.075***	−0.103***	−0.097***	−0.104***	−0.097***	−0.198***	−0.189***	−0.199***	−0.190***
	(−3.312)	(−3.206)	(−3.320)	(−3.212)	(−4.373)	(−4.076)	(−4.407)	(−4.107)	(−8.695)	(−8.265)	(−8.758)	(−8.344)
age15	−0.077***	−0.075***	−0.077***	−0.075***	−0.056**	−0.051**	−0.056**	−0.051**	−0.166***	−0.157***	−0.170***	−0.161***
	(−3.203)	(−3.114)	(−3.191)	(−3.100)	(−2.400)	(−2.162)	(−2.412)	(−2.175)	(−7.442)	(−6.757)	(−7.701)	(−6.992)
age10	−0.060***	−0.060***	−0.060***	−0.060***	−0.077***	−0.073***	−0.078***	−0.073***	−0.214***	−0.202***	−0.215***	−0.204***
	(−3.354)	(−3.331)	(−3.358)	(−3.334)	(−3.627)	(−3.285)	(−3.646)	(−3.297)	(−10.104)	(−9.680)	(−10.074)	(−9.680)
age5	−0.004	−0.004	−0.004	−0.004	−0.021	−0.019	−0.022	−0.019	−0.110***	−0.103***	−0.110***	−0.103***
R Square	0.116	0.116	0.116	0.116	0.165	0.163	0.166	0.164	0.252	0.248	0.253	0.249
Model N	16,186	16,186	16,186	16,186	16,219	16,219	16,219	16,219	16,225	16,225	16,225	16,045
ESTAR-N	30	30	30	30	186	186	186	186	2,257	2,257	2,257	2,257
LEED-N	11	11	11	11	38	38	38	38	229	229	229	229
Dual-N	0	0	0	0	7	7	7	7	621	621	621	621
Non-Eco-N	16,203	16,203	16,203	16,203	16,014	16,014	16,014	16,014	13,137	13,137	13,137	13,137
Prof Owner	568	568	568	568	1,872	1,872	1,872	1,872	5,884	5,884	5,884	5,884
Weighting			X	X			X	X			X	X
Market Fixed Effects	X	X	X	X	X	X	X	X	X	X	X	X

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continued from previous page

Variable	Smallest 1/3 Buildings > 21,212 SF				Mid 1/3 Buildings				Largest 1/3 Buildings > 53,758 SF			
	Model1	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**	**Model10**	**Model11**	**Model12**
	(−0.250)	(−0.239)	(−0.250)	(−0.238)	(−1.163)	(−1.030)	(−1.207)	(−1.072)	(−5.618)	(−5.122)	(−5.612)	(−5.102)
Renovated	0.056***	0.055***	0.056***	0.056***	0.032**	0.031**	0.032**	0.031**	0.002	−0.000	0.000	−0.002
	(2.681)	(2.683)	(2.703)	(2.706)	(2.586)	(2.462)	(2.591)	(2.462)	(0.134)	(−0.005)	(0.001)	(−0.129)
Percent Leased	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(8.915)	(8.934)	(8.911)	(8.930)	(9.047)	(8.928)	(9.064)	(8.946)	(6.002)	(5.945)	(5.895)	(5.836)
stories	0.074***	0.074***	0.074***	0.074***	0.045***	0.045***	0.045***	0.045***	0.008**	0.008**	0.007*	0.007*
	(4.332)	(4.315)	(4.329)	(4.311)	(4.568)	(4.497)	(4.560)	(4.489)	(2.114)	(2.055)	(1.988)	(1.930)
A Class	0.554**	0.560**	0.554**	0.560**	0.277***	0.282***	0.278***	0.282***	0.321***	0.330***	0.323***	0.332***
	(2.518)	(2.493)	(2.500)	(2.475)	(10.153)	(10.542)	(10.073)	(10.463)	(8.489)	(8.687)	(8.746)	(8.938)
B Class	0.127***	0.128***	0.127***	0.128***	0.145***	0.147***	0.145***	0.148***	0.149***	0.153***	0.150***	0.153***
	(10.754)	(10.737)	(10.797)	(10.780)	(8.570)	(8.768)	(8.536)	(8.735)	(5.313)	(5.362)	(5.452)	(5.496)
NNN	−0.082***	−0.082***	−0.082***	−0.082***	−0.142***	−0.141***	−0.143***	−0.141***	−0.236***	−0.236***	−0.238***	−0.238***
	(−5.185)	(−5.188)	(−5.185)	(−5.189)	(−6.899)	(−6.683)	(−6.885)	(−6.666)	(−4.406)	(−4.371)	(−4.302)	(−4.269)
FSG	0.054***	0.055***	0.054***	0.055***	0.050*	0.050*	0.050*	0.050*	0.043	0.045	0.043	0.045
	(2.980)	(2.995)	(2.975)	(2.990)	(1.969)	(1.971)	(1.955)	(1.956)	(0.667)	(0.687)	(0.650)	(0.671)
Amenity	0.005	0.005	0.005	0.005	−0.001	0.000	−0.001	0.000	−0.006	−0.005	−0.006	−0.005
	(0.299)	(0.306)	(0.296)	(0.303)	(−0.034)	(0.018)	(−0.050)	(0.003)	(−0.341)	(−0.268)	(−0.321)	(−0.244)
R Square	0.116	0.116	0.116	0.116	0.165	0.163	0.166	0.164	0.252	0.248	0.253	0.249
Model N	16, 186	16, 186	16, 186	16, 186	16, 219	16, 219	16, 219	16, 219	16, 225	16, 225	16, 225	16, 045
ESTAR-N	30	30	30	30	186	186	186	186	2,257	2,257	2,257	2,257
LEED-N	11	11	11	11	38	38	38	38	229	229	229	229
Dual-N	0	0	0	0	7	7	7	7	621	621	621	621
Non-Eco-N	16,203	16,203	16,203	16,203	16,014	16,014	16,014	16,014	13,137	13,137	13,137	13,137
Prof Owner	568	568	568	568	1,872	1,872	1,872	1,872	5,884	5,884	5,884	5,884
Weighting			X	X			X	X			X	X
Market Fixed Effects	X	X	X	X	X	X	X	X	X	X	X	X

Table 7: This table presents results from fixed effect regressions by market on sales PSF of the building population split into thirds by the ESTAR distribution. In each size category results are presented first with the core controls, then with professional ownership controls added, then with sale condition controls also added, and finally weighted by price with all controls. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	size<=151,775				Medium				size>=280,563			
Variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**	**Model10**	**Model11**	**Mo**
ESTAR	37.117***	26.444***	27.926***	10.096	33.862***	33.262***	34.758***	30.648***	−3.258	−7.352	−7.369	−99.4
	(4.589)	(3.608)	(3.711)	(0.908)	(4.208)	(4.169)	(4.176)	(2.975)	(−0.089)	(−0.208)	(−0.229)	(−3.1
LEED	69.178***	67.784**	66.177**	71.302**	71.291**	64.927**	73.117**	83.853***	67.103*	60.091	58.835*	−16.5
	(2.676)	(2.664)	(2.621)	(2.178)	(2.220)	(2.299)	(2.523)	(3.179)	(1.809)	(1.584)	(1.723)	(−0.3
Dual	27.137	25.954	25.123	−9.148	63.001***	64.879***	62.386***	48.626***	5.675	1.652	2.219	−108
	(1.504)	(1.492)	(1.470)	(−0.210)	(4.879)	(4.963)	(4.554)	(2.762)	(0.139)	(0.041)	(0.060)	(−3.3
Prof Buyer		62.006***	62.935***	34.438***		18.005	18.866	12.873		7.304	7.582	−12.1
		(6.171)	(6.434)	(3.645)		(1.161)	(1.160)	(0.716)		(0.604)	(0.612)	(−0.5
Prof Seller		43.338***	41.561***	69.864***		90.685***	85.504***	96.476***		83.489***	77.083***	52.37
		(3.499)	(3.560)	(2.985)		(3.180)	(2.965)	(5.808)		(3.298)	(3.312)	(1.95
Prof Both		49.579	52.176	−19.032		36.127	34.523	2.529		118.446**	115.346**	192.0
		(1.102)	(1.169)	(−0.304)		(0.998)	(0.965)	(0.141)		(2.446)	(2.269)	(2.44
Intercept	357.583***	375.633***	377.120***	832.197***	529.275***	500.013***	518.807***	1003.42***	−214.04	−224.34	−228.44	−668
	(5.449)	(5.616)	(5.215)	(2.977)	(3.103)	(2.845)	(3.213)	(3.110)	(−0.699)	(−0.738)	(−0.680)	(−4.2
lnsize	−18.383***	−20.258***	−21.386***	−34.298**	−6.782	−4.854	−5.918	−30.146	63.044**	62.924**	63.747**	139.9
	(−5.002)	(−5.612)	(−5.345)	(−2.092)	(−0.295)	(−0.211)	(−0.285)	(−0.953)	(2.304)	(2.308)	(2.158)	(10.5
age100	30.948	30.900	30.762	151.669	−5.780	−2.684	−7.809	53.979	−52.164	−45.289	−43.156	54.31
	(0.870)	(0.867)	(0.870)	(1.450)	(−0.124)	(−0.062)	(−0.179)	(1.508)	(−0.899)	(−0.817)	(−0.718)	(1.29
age75	19.138	19.394	19.644	99.752	−29.106	−22.365	−26.879	50.834	−83.811**	−80.901**	−85.239***	−55.0
	(0.720)	(0.729)	(0.751)	(1.338)	(−0.689)	(−0.548)	(−0.642)	(1.116)	(−2.623)	(−2.653)	(−2.922)	(−1.3
age50	8.103	7.514	7.924	67.474	−78.639***	−71.070***	−70.562***	−103.40***	−98.621***	−96.169***	−94.703***	47.52
	(0.630)	(0.589)	(0.634)	(0.831)	(−3.121)	(−3.171)	(−2.996)	(−3.489)	(−3.568)	(−3.532)	(−3.087)	(1.08
age40	2.616	1.723	2.579	−17.767	−51.413***	−43.760**	−48.237***	−21.320	−68.187**	−67.179**	−72.259**	35.20
	(0.282)	(0.190)	(0.290)	(−0.894)	(−3.230)	(−2.622)	(−2.875)	(−0.697)	(−2.376)	(−2.553)	(−2.653)	(1.17
age30	5.171	4.581	5.079	−18.500	−43.324***	−37.599**	−40.938**	−52.977**	−114.18***	−111.67***	−112.95***	−80.5
	(0.533)	(0.476)	(0.530)	(−0.833)	(−2.687)	(−2.326)	(−2.479)	(−2.303)	(−4.797)	(−5.237)	(−5.231)	(−1.7
age20	14.315	13.275	13.208	−8.092	−36.932**	−33.663**	−37.004**	−51.302***	−109.01***	−106.94***	−107.86***	−88.2
	(1.561)	(1.462)	(1.475)	(−0.390)	(−2.446)	(−2.231)	(−2.605)	(−3.496)	(−4.383)	(−4.436)	(−4.451)	(−2.9
age15	35.240***	34.764***	32.211***	43.680	−12.714	−9.419	−19.949	−32.195	−92.839***	−96.109***	−98.277***	−85.0
	(3.425)	(3.366)	(3.160)	(1.075)	(−0.797)	(−0.587)	(−1.136)	(−1.501)	(−2.901)	(−3.258)	(−3.375)	(−1.6
R Square	0.112	0.116	0.132	0.237	0.293	0.308	0.336	0.455	0.248	0.261	0.276	0.498
Model N	22,819	22,819	22,819	22,819	1,521	1,521	1,521	1,521	1,175	1,175	1,175	1,175
ESTAR-N	311	311	311	311	310	310	310	310	312	312	312	312
LEED N	93	93	93	93	35	35	35	35	30	30	30	30
Dual-N	32	32	32	32	71	71	71	71	192	192	192	192
Non-Eco-N	23,093	23,093	23,093	23,093	1,122	1,122	1,122	1,122	660	660	660	660
Prof Seller N	180	180	180	180	55	55	55	55	51	51	51	51
Prof Buyer N	434	434	434	434	211	211	211	211	204	204	204	204
Prof Both N	23	23	23	23	21	21	21	21	23	23	23	23
Market Fixed Effects	X	X	X	X	X	X	X	X	X	X	X	X
Sale Condition Controls			X	X			X	X			X	X
Weighting				X				X				X

Continued on next page

Continued from previous page

Variable	Model1	Model2	Model3	Model4	Model5	Model6	Model7	Model8	Model9	Model10	Model11	Mod
		size<=151,775				**Medium**				**size>=280,563**		
age10	46.378***	45.804***	44.074***	43.085	24.101	28.228	18.202	6.411	−55.154*	−58.425**	−58.417**	−16.8
	(4.568)	(4.515)	(4.402)	(1.651)	(1.180)	(1.421)	(1.014)	(0.374)	(−1.887)	(−2.343)	(−2.219)	(−0.4
age5	46.093***	45.656***	44.051***	45.536***	40.290**	43.615**	32.520**	10.688	8.763	9.718	10.963	53.00
	(5.669)	(5.637)	(5.575)	(2.739)	(2.184)	(2.536)	(2.119)	(0.706)	(0.311)	(0.372)	(0.402)	(1.52
stories	8.881***	8.868***	9.285***	15.471***	−0.342	−0.382	−0.241	2.434	−1.392	−1.435	−1.415	−2.5
	(2.884)	(2.885)	(3.026)	(7.857)	(−0.150)	(−0.176)	(−0.115)	(1.366)	(−1.191)	(−1.342)	(−1.358)	(−2.5
A Class	67.296***	63.792***	64.175***	95.620**	88.541***	85.340***	83.628***	144.390***	132.071***	129.015***	115.274***	139.1
	(9.177)	(9.328)	(8.968)	(2.470)	(4.137)	(4.244)	(4.098)	(4.791)	(3.943)	(3.949)	(4.095)	(4.03
B Class	26.151***	25.886***	25.325***	35.894**	44.618***	41.840***	41.411**	93.849***	52.273*	50.724*	39.844*	5.072
	(8.387)	(8.422)	(8.363)	(2.519)	(2.915)	(2.845)	(2.606)	(3.639)	(1.881)	(1.957)	(1.963)	(0.10
lnland	−11.802*	−11.583*	−11.486*	−37.788**	−34.196**	−33.541***	−33.999***	−51.157***	−40.900***	−39.757***	−39.815***	−84.8
	(−1.867)	(−1.838)	(−1.849)	(−2.317)	(−2.564)	(−2.790)	(−2.775)	(−4.920)	(−3.160)	(−3.241)	(−3.341)	(−4.6
Amenity	4.003	3.593	3.122	−20.519*	42.032***	37.944***	40.471***	16.969	52.945	52.154	52.641	74.56
	(1.065)	(0.942)	(0.870)	(−1.744)	(4.078)	(3.648)	(3.738)	(1.180)	(1.312)	(1.276)	(1.136)	(1.10
Year 2002	7.254	7.119	7.051	67.240	22.693**	20.437**	16.332	−4.467	−18.461	−18.589	−18.585	−9.08
	(1.221)	(1.201)	(1.235)	(1.117)	(2.438)	(2.162)	(1.658)	(−0.336)	(−1.245)	(−1.207)	(−1.072)	(−0.1
Year 2003	6.533	6.364	6.775	−3.670	2.124	0.814	1.389	−21.464	−13.557	−11.065	1.116	1.114
	(1.293)	(1.261)	(1.360)	(−0.282)	(0.154)	(0.061)	(0.115)	(−1.458)	(−0.497)	(−0.412)	(0.039)	(0.01
Year 2004	12.249**	12.062**	12.978***	1.064	16.738	16.210	16.919	7.490	−15.829	−12.685	−10.794	−18.8
	(2.633)	(2.571)	(2.912)	(0.082)	(1.129)	(1.148)	(1.236)	(0.650)	(−0.694)	(−0.559)	(−0.457)	(−0.2
Year 2005	27.578***	27.032***	28.594***	42.650*	36.095***	34.488***	34.185**	23.193	4.741	2.915	9.057	−22.0
	(3.627)	(3.592)	(4.038)	(1.711)	(2.877)	(2.913)	(2.656)	(1.510)	(0.204)	(0.127)	(0.372)	(−0.5
Year 2006	50.079***	49.587***	50.395***	84.514**	58.528***	55.334***	56.211***	60.009***	29.768	29.620	33.163	54.61
	(4.329)	(4.318)	(4.516)	(2.005)	(3.524)	(3.704)	(3.542)	(3.330)	(1.285)	(1.299)	(1.355)	(0.83
Year 2007	58.145***	56.636***	58.753***	78.633**	67.315***	63.135***	65.003***	100.140***	53.283	52.134	59.256	146.9
	(5.035)	(4.984)	(5.478)	(2.557)	(2.972)	(2.934)	(2.923)	(2.753)	(1.498)	(1.453)	(1.514)	(1.41
Year 2008	64.706***	61.039***	64.188***	118.237**	79.445***	67.556***	70.931***	98.155***	120.813*	108.879	116.242	275.6
	(3.995)	(3.846)	(4.289)	(2.443)	(3.504)	(3.176)	(3.235)	(3.603)	(1.772)	(1.561)	(1.576)	(1.95
Year 2009	55.549***	53.020***	55.838***	118.237**	105.346***	94.549***	94.463***	145.305***	71.348	65.682	68.657	276.0
	(3.808)	(3.687)	(4.138)	(2.129)	(3.120)	(3.217)	(3.306)	(4.403)	(1.176)	(1.097)	(1.083)	(2.04
Year 2010	18.717	15.907	23.707**	78.164**	42.960*	32.199	48.460**	108.443***	37.610	29.907	47.782*	53.63
	(1.620)	(1.412)	(2.287)	(2.206)	(1.713)	(1.636)	(2.269)	(2.707)	(1.294)	(1.060)	(1.767)	(0.81
Year 2011	20.487	17.517	28.054*	145.174**	61.036**	47.664**	65.967***	101.704***	55.853**	40.280	57.716**	78.69
	(1.243)	(1.081)	(1.882)	(2.089)	(2.194)	(2.076)	(2.843)	(3.598)	(2.073)	(1.626)	(2.107)	(1.17
1031			31.110***	3.521			13.902	−8.872			39.635***	13.87
R Square	0.112	0.116	0.132	0.237	0.293	0.308	0.336	0.455	0.248	0.261	0.276	0.498
Model N	22,819	22,819	22,819	22,819	1,521	1,521	1,521	1,521	1,175	1,175	1,175	1,175
ESTAR-N	311	311	311	311	310	310	310	310	312	312	312	312
LEED N	93	93	93	93	35	35	35	35	30	30	30	30
Dual-N	32	32	32	32	71	71	71	71	192	192	192	192
Non-Eco-N	23,093	23,093	23,093	23,093	1,122	1,122	1,122	1,122	660	660	660	660
Prof Seller N	180	180	180	180	55	55	55	55	51	51	51	51
Prof Buyer N	434	434	434	434	211	211	211	211	204	204	204	204
Prof Both N	23	23	23	23	21	21	21	21	23	23	23	23
Market Fixed Effects	X	X	X	X	X	X	X	X	X	X	X	X
Sale Condition Controls			X	X			X	X			X	X
Weighting				X				X				X

Continued on next page

Continued from previous page

Variable	Model1	Model2	Model3	Model4	Model5	Model6	Model7	Model8	Model9	Model10	Model11	Mo
	size<=151,775				**Medium**				**size>=280,563**			
			(6.458)	(0.262)			(1.400)	(−0.616)			(2.983)	(0.75
Assemblage			29.671**	9.563			5.514	−56.265			175.667***	97.76
			(2.150)	(0.453)			(0.135)	(−0.613)			(3.616)	(2.16
Build to Suit			42.339***	17.236			7.135	32.736			−106.34*	−8.1
			(4.841)	(1.186)			(0.238)	(0.860)			(−1.917)	(−0.
Business Value			22.515	193.180			150.328***	70.442			−7.450	−94.
			(0.927)	(1.257)			(3.732)	(0.907)			(−0.111)	(−0.
Condo Conversion			42.132	128.739			−9.481	−66.914**			85.651	139.6
			(1.394)	(1.368)			(−0.393)	(−2.395)			(1.007)	(3.10
Contamination			−38.081*	−139.86			0.000	0.000			−96.550	−173
			(−1.702)	(−1.525)			(.)	(.)			(−1.287)	(−2.
Deed Restriction			−7.611	−6.043			0.000	0.000			−150.11**	−147
			(−0.578)	(−0.197)			(.)	(.)			(−2.576)	(−1.
Deferred Maintenance			−25.457***	−3.334			−32.677	5.550			−49.380	−73.
			(−4.208)	(−0.142)			(−1.081)	(0.060)			(−1.657)	(−1.
Distressed Sale			−25.425***	−71.629**			−54.306	−125.33***			−31.487	320.9
			(−3.853)	(−2.354)			(−1.578)	(−4.390)			(−1.022)	(5.95
Ground Lease			46.804**	120.952**			−4.507	−9.229			17.261	43.51
			(2.474)	(2.065)			(−0.295)	(−0.418)			(0.832)	(1.17
High Vacancy			−0.703	36.156			−71.011***	−100.17***			−45.951**	−120
			(−0.046)	(0.564)			(−7.752)	(−7.606)			(−2.574)	(−3.
Historical			−19.201	−18.053			−4.582	−108.51**			−24.699	−26.
			(−1.353)	(−0.264)			(−0.077)	(−2.204)			(−0.304)	(−0.
Investor NNN			33.336***	43.476**			10.221	12.689			−2.047	−39.
			(6.539)	(2.303)			(0.739)	(0.715)			(−0.146)	(−1.
Land Contract			−61.937***	−148.72***			0.000	0.000			0.000	0.000
			(−6.185)	(−3.559)			(.)	(.)			(.)	(.)
Option Sale			19.640**	−33.519			63.511	120.812**			−72.012*	−115
			(2.352)	(−1.154)			(1.175)	(2.475)			(−1.822)	(−2.
Partial Interest			−12.478	292.332			12.887	20.613			−17.926	−137
			(−0.405)	(1.346)			(0.202)	(0.274)			(−0.562)	(−2.
Redevelopment			47.718	59.085**			−22.832	−32.223			−90.942**	−129
			(1.625)	(2.407)			(−0.943)	(−0.503)			(−2.429)	(−2.
REO			−54.813***	−149.39***			−78.424***	−164.68***			−13.062	−54.
			(−5.548)	(−3.415)			(−3.000)	(−3.997)			(−0.241)	(−2.
R Square	0.112	0.116	0.132	0.237	0.293	0.308	0.336	0.455	0.248	0.261	0.276	0.498
Model N	22, 819	22, 819	22, 819	22, 819	1, 521	1, 521	1, 521	1, 521	1, 175	1, 175	1, 175	1, 175
ESTAR-N	311	311	311	311	310	310	310	310	312	312	312	312
LEED N	93	93	93	93	35	35	35	35	30	30	30	30
Dual-N	32	32	32	32	71	71	71	71	192	192	192	192
Non-Eco-N	23,093	23,093	23,093	23,093	1,122	1,122	1,122	1,122	660	660	660	660
Prof Seller N	180	180	180	180	55	55	55	55	51	51	51	51
Prof Buyer N	434	434	434	434	211	211	211	211	204	204	204	204
Prof Both N	23	23	23	23	21	21	21	21	23	23	23	23
Market Fixed Effects	X	X	X	X	X	X	X	X	X	X	X	X
Sale Condition Controls			X	X			X	X			X	X
Weighting				X				X				X

Continued on next page

Continued from previous page

Variable	Model1	Model2	Model3	Model4	Model5	Model6	Model7	Model8	Model9	Model10	Model11	Mod
		size<=151,775				**Medium**				**size>=280,563**		
Sale Leaseback			19.426***	14.377			23.598	46.273			12.207	−39.
			(4.240)	(0.738)			(1.302)	(1.621)			(0.805)	(−1.1
Shell Condition			21.243	−46.434*			−24.369*	−51.526**			−101.87***	−275
			(1.653)	(−1.760)			(−1.736)	(−2.508)			(−3.065)	(−4.5
Short Sale			−48.647***	−158.46***			0.000	0.000			−55.253*	−52.
			(−3.062)	(−3.901)			(.)	(.)			(−1.869)	(−1.5
Single Tenant			9.087***	25.959*			6.077	11.625			11.573	36.75
			(2.727)	(1.999)			(0.733)	(0.948)			(0.447)	(0.98
Tenant Purchase			8.286*	17.946**			37.130	76.932***			54.107	62.27
			(1.697)	(2.131)			(1.481)	(3.137)			(1.536)	(1.23
R Square	0.112	0.116	0.132	0.237	0.293	0.308	0.336	0.455	0.248	0.261	0.276	0.498
Model N	22,819	22,819	22,819	22,819	1,521	1,521	1,521	1,521	1,175	1,175	1,175	1,175
ESTAR-N	311	311	311	311	310	310	310	310	312	312	312	312
LEED N	93	93	93	93	35	35	35	35	30	30	30	30
Dual-N	32	32	32	32	71	71	71	71	192	192	192	192
Non-Eco-N	23,093	23,093	23,093	23,093	1,122	1,122	1,122	1,122	660	660	660	660
Prof Seller N	180	180	180	180	55	55	55	55	51	51	51	51
Prof Buyer N	434	434	434	434	211	211	211	211	204	204	204	204
Prof Both N	23	23	23	23	21	21	21	21	23	23	23	23
Market Fixed Effects	X	X	X	X	X	X	X	X	X	X	X	X
Sale Condition Controls			X	X			X	X			X	X
Weighting				X				X				X

Table 8: This table presents results from fixed effect regressions by market on sales PSF of the building population split into thirds by size. In each size category results are presented first with the core controls, then with professional ownership controls added, then with sale condition controls also added, and finally weighted by price with all controls. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	>17,435 SF				Medium				>44,019 SF			
Variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**	**Model10**	**Model11**	**Mod**
ESTAR	−33.600*	−33.257*	−30.937	−78.067***	77.326***	61.485**	64.236**	88.994*	26.742**	22.079*	22.162*	−63.9
	(−1.870)	(−1.852)	(−1.569)	(−3.202)	(3.015)	(2.117)	(2.255)	(1.849)	(2.008)	(1.833)	(1.841)	(−2.0
LEED	19.430	20.034	13.209	112.383	54.839	55.035	57.404	131.717**	87.599***	80.738***	81.229***	11.486
	(0.388)	(0.401)	(0.258)	(1.203)	(1.440)	(1.443)	(1.562)	(2.132)	(5.458)	(5.690)	(5.690)	(0.316
Dual	−9.286	−8.992	−33.971	−141.42	−49.176**	−48.246**	−56.240*	−66.741**	39.549*	35.814	35.179	−78.6
	(−0.311)	(−0.300)	(−0.820)	(−1.159)	(−2.511)	(−2.450)	(−1.688)	(−2.104)	(1.690)	(1.572)	(1.574)	(−2.4
Prof Buyer		209.315***	212.689***	344.407		124.069***	125.297***	272.399		27.708***	28.473***	0.782
		(2.776)	(2.698)	(1.200)		(3.481)	(3.452)	(1.635)		(2.931)	(3.009)	(0.040
Prof Seller		18.920	22.199	5.054		31.086**	28.348*	−6.306		72.260***	68.176***	60.985
		(0.775)	(0.875)	(0.219)		(2.112)	(1.997)	(−0.159)		(4.018)	(3.849)	(2.753
Prof Both		0.000	0.000	0.000		−107.07***	−130.02***	−491.96**		78.632**	78.004**	150.11
		(.)	(.)	(.)		(−11.823)	(−4.211)	(−2.649)		(2.070)	(2.063)	(2.619
Intercept	443.192***	445.988***	458.706***	862.363**	407.848***	416.662***	408.203***	1614.32*	233.033***	247.762***	241.093***	158.34
	(5.717)	(5.817)	(5.018)	(2.539)	(3.115)	(3.149)	(2.945)	(1.862)	(3.834)	(4.373)	(4.349)	(2.147
lnsize	−39.744***	−40.140***	−42.450***	−84.103**	−28.961**	−29.830**	−30.164**	−136.91*	12.773	11.139	11.299	60.633
	(−4.440)	(−4.528)	(−3.963)	(−2.207)	(−2.454)	(−2.521)	(−2.453)	(−1.749)	(1.082)	(1.050)	(1.070)	(6.596
age100	25.108	23.873	23.472	104.870*	23.800	23.197	23.090	250.086	1.008	2.820	3.228	53.793
	(1.061)	(1.026)	(0.998)	(1.781)	(0.649)	(0.633)	(0.644)	(1.479)	(0.026)	(0.074)	(0.086)	(1.357
age75	27.362	26.710	23.745	68.600**	14.534	14.553	14.933	177.255	−8.284	−6.799	−5.411	1.133
	(1.260)	(1.227)	(1.207)	(2.395)	(0.512)	(0.513)	(0.541)	(1.562)	(−0.258)	(−0.216)	(−0.177)	(0.051
age50	21.694	20.990	20.761	129.590***	2.284	1.745	2.624	23.131	−28.023	−27.842	−26.260	47.898
	(1.265)	(1.244)	(1.228)	(2.730)	(0.226)	(0.171)	(0.272)	(0.614)	(−1.368)	(−1.369)	(−1.300)	(1.176
age40	4.704	4.267	3.715	−0.504	3.159	3.146	4.971	−1.818	−15.420	−16.580	−16.190	46.340
	(0.420)	(0.381)	(0.340)	(−0.026)	(0.335)	(0.331)	(0.546)	(−0.103)	(−1.254)	(−1.399)	(−1.407)	(1.567
age30	14.519	13.930	12.767	13.941	3.351	3.252	3.841	3.896	−26.315**	−26.776**	−25.776**	−73.1
	(1.242)	(1.199)	(1.140)	(0.653)	(0.335)	(0.322)	(0.389)	(0.151)	(−2.411)	(−2.465)	(−2.536)	(−3.1
age20	17.827	16.998	16.367	9.084	14.827	14.241	13.588	21.345	−16.402	−18.192*	−17.946*	−71.1
	(1.559)	(1.499)	(1.511)	(0.546)	(1.609)	(1.515)	(1.495)	(0.886)	(−1.621)	(−1.800)	(−1.853)	(−4.1
age15	35.244***	34.771***	30.676**	34.532	36.896***	35.896***	33.753***	38.892	10.411	9.576	6.867	−38.4
	(2.783)	(2.768)	(2.483)	(1.370)	(3.461)	(3.369)	(3.242)	(1.561)	(0.840)	(0.767)	(0.569)	(−0.9
age10	49.112***	48.702***	49.093***	75.489***	44.467***	44.599***	42.345***	53.633**	28.912**	27.447**	24.979**	2.053
R Square	0.114	0.120	0.151	0.563	0.106	0.113	0.131	0.290	0.209	0.219	0.233	0.415
Model N	8,460	8,460	8,460	8,460	8,476	8,476	8,476	8,476	8,579	8,579	8,579	8,579
ESTAR-N	10	10	10	10	24	24	24	24	899	899	899	899
Dual-N	5	5	5	5	4	4	4	4	286	286	286	286
LEED N	14	14	14	14	26	26	26	26	118	118	118	118
Prof Seller N	15	15	15	15	45	45	45	45	226	226	226	226
Prof Buyer N	18	18	18	18	60	60	60	60	771	771	771	771
Prof Both N	0	0	0	0	1	1	1	1	66	66	66	66
Market Fixed Effects	X	X	X	X	X	X	X	X	X	X	X	X
Sale Condition Controls			X	X			X	X			X	X
Weighting				X				X				X

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Variable	>17,435 SF Model1	Model2	Model3	Model4	Medium Model5	Model6	Model7	Model8	>44,000 SF Model9	Model10	Model11	Mod
	(3.545)	(3.542)	(3.495)	(2.711)	(4.751)	(4.671)	(4.528)	(2.217)	(2.326)	(2.172)	(2.111)	(0.111
age5	50.276***	49.660***	47.798***	60.979***	41.814***	41.910***	41.070***	43.827**	44.327***	43.800***	40.951***	46.65
	(4.298)	(4.287)	(4.329)	(3.015)	(4.241)	(4.204)	(4.256)	(2.282)	(4.171)	(4.217)	(4.092)	(2.260
stories	29.093*	28.698	29.150*	80.685***	14.381**	14.231**	14.750**	33.458***	0.730	0.714	0.750	0.151
	(1.684)	(1.670)	(1.745)	(4.024)	(2.317)	(2.330)	(2.432)	(10.940)	(0.502)	(0.510)	(0.534)	(0.148
A Class	75.449	75.387	72.849	133.546	46.525***	45.263***	47.175***	80.019**	87.407***	85.054***	84.150***	141.3
	(1.126)	(1.128)	(1.067)	(1.259)	(3.344)	(3.418)	(3.663)	(2.297)	(8.695)	(8.926)	(8.941)	(6.648
B Class	22.440***	22.399***	21.675***	21.216**	23.679***	22.934***	22.230***	13.076*	43.947***	43.190***	42.599***	58.87
	(6.050)	(6.045)	(5.895)	(2.031)	(7.648)	(7.585)	(7.270)	(1.811)	(7.152)	(7.256)	(7.343)	(6.274
lnland	−5.325	−5.093	−4.920	−12.727	−7.518	−7.412	−7.261	−19.623	−27.238***	−26.605***	−26.611***	−66.4
	(−1.473)	(−1.408)	(−1.388)	(−1.513)	(−1.544)	(−1.523)	(−1.494)	(−1.501)	(−3.246)	(−3.426)	(−3.441)	(−4.4
Amenity	4.154	4.331	3.311	−20.436	4.877	4.813	3.874	−19.411	10.494**	9.082**	10.434**	10.28
	(0.757)	(0.794)	(0.676)	(−1.548)	(1.326)	(1.298)	(1.089)	(−1.289)	(2.318)	(2.036)	(2.326)	(0.434
Year 2002	10.919*	10.867*	11.106**	35.658	3.791	3.886	4.639	10.418	8.020	7.226	4.684	27.27
	(1.812)	(1.805)	(2.058)	(1.047)	(0.657)	(0.674)	(0.895)	(0.806)	(1.281)	(1.174)	(0.817)	(0.595
Year 2003	10.642*	10.564*	11.566*	10.652	12.378**	12.554**	13.087**	16.832	−9.603	−9.733	−9.822	−28.2
	(1.834)	(1.835)	(1.997)	(0.427)	(2.055)	(2.082)	(2.287)	(0.993)	(−1.510)	(−1.555)	(−1.564)	(−1.0
Year 2004	22.019***	21.950***	22.656***	20.478	11.213**	11.319**	12.483**	3.992	−0.278	−0.425	−0.343	−26.5
	(3.558)	(3.572)	(4.206)	(1.312)	(2.025)	(2.032)	(2.310)	(0.183)	(−0.039)	(−0.061)	(−0.049)	(−1.1
Year 2005	41.685***	41.591***	42.450***	56.462*	21.018***	20.702***	23.137***	22.756	14.720*	13.507*	14.294*	−5.72
	(4.531)	(4.548)	(5.216)	(1.887)	(2.910)	(2.886)	(3.403)	(0.904)	(1.784)	(1.688)	(1.805)	(−0.2
Year 2006	61.119***	60.508***	60.166***	93.467**	50.623***	49.760***	51.365***	92.890**	35.428***	34.093***	34.392***	50.04
	(5.514)	(5.515)	(5.677)	(2.300)	(4.409)	(4.495)	(4.755)	(2.095)	(2.882)	(2.827)	(2.854)	(1.514
Year 2007	70.611***	70.221***	70.146***	95.295***	61.959***	61.591***	63.862***	104.329**	44.238***	40.509***	42.649***	108.4
	(5.760)	(5.779)	(6.653)	(4.096)	(4.643)	(4.643)	(5.057)	(2.533)	(3.111)	(2.879)	(2.992)	(1.680
Year 2008	67.184***	65.708***	67.681***	104.136***	68.317***	65.718***	69.050***	146.157**	66.826***	57.891**	61.065**	192.2
	(5.173)	(5.261)	(6.182)	(3.083)	(3.422)	(3.359)	(3.697)	(2.394)	(2.748)	(2.364)	(2.462)	(1.993
Year 2009	69.951***	68.124***	69.727***	160.335***	49.727***	48.262***	51.124***	107.978**	55.216***	47.249**	49.385**	184.9
	(3.717)	(3.720)	(4.514)	(3.616)	(3.686)	(3.647)	(4.189)	(2.256)	(2.831)	(2.499)	(2.576)	(2.274
Year 2010	26.614**	25.968**	31.589***	67.777**	15.103	13.287	20.947**	49.222*	19.568	11.342	23.958	68.58
	(2.313)	(2.287)	(3.357)	(2.603)	(1.334)	(1.198)	(2.060)	(1.702)	(1.280)	(0.791)	(1.632)	(2.250
Year 2011	24.959	24.312	31.404**	100.641**	15.252	13.255	23.394	174.983*	32.955**	22.424	39.707***	72.47
	(1.529)	(1.514)	(2.280)	(2.275)	(0.846)	(0.744)	(1.423)	(1.845)	(2.062)	(1.592)	(2.743)	(2.844
1031			35.986***	13.357			34.635***	24.802**			23.441***	8.265
			(5.299)	(0.600)			(6.168)	(2.012)			(5.498)	(0.689
Assemblage			51.815**	81.440**			18.592	−33.850			−5.107	−21.3
R Square	0.114	0.120	0.151	0.563	0.106	0.113	0.131	0.290	0.209	0.219	0.233	0.415
Model N	8,460	8,460	8,460	8,460	8,476	8,476	8,476	8,476	8,579	8,579	8,579	8,579
ESTAR-N	10	10	10	10	24	24	24	24	899	899	899	899
Dual-N	5	5	5	5	4	4	4	4	286	286	286	286
LEED N	14	14	14	14	26	26	26	26	118	118	118	118
Prof Seller N	15	15	15	15	45	45	45	45	226	226	226	226
Prof Buyer N	18	18	18	18	60	60	60	60	771	771	771	771
Prof Both N	0	0	0	0	1	1	1	1	66	66	66	66
Market Fixed Effects	X	X	X	X	X	X	X	X	X	X	X	X
Sale Condition Controls			X	X			X	X			X	X
Weighting				X				X				X

Continued on next page

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Variable	Model1	Model2	Model3	Model4	Model5	Model6	Model7	Model8	Model9	Model10	Model11	Mod
		>17,435 SF				**Medium**				**>44,000 SF**		
			(2.271)	(2.426)			(1.158)	(−0.688)			(−0.213)	(−0.3
Build to Suit			32.206	29.643			72.752***	49.946**			2.696	0.575
			(1.545)	(1.029)			(4.288)	(2.286)			(0.183)	(0.020
Business Value			−18.017	−124.38			18.647	13.262			89.793	16.995
			(−1.102)	(−1.523)			(1.284)	(0.531)			(1.228)	(0.168
Condo Conversion			175.560	554.201***			18.123	−53.455			25.727	70.370
			(1.051)	(4.235)			(1.072)	(−0.771)			(0.857)	(1.107
Contamination			−46.436*	−137.87***			−30.784	−223.39			−64.050***	−149.
			(−1.794)	(−2.985)			(−0.984)	(−1.204)			(−3.274)	(−4.9
Deed Restriction			−16.423	−71.986			−7.579	−44.110			−13.205	−10.3
			(−0.443)	(−0.650)			(−0.596)	(−1.448)			(−0.524)	(−0.1
Deferred Maintenance			−25.024**	−68.608**			−26.953***	−75.923			−23.664***	−12.0
			(−2.648)	(−2.557)			(−2.685)	(−1.403)			(−4.599)	(−0.2
Distressed Sale			−29.633**	42.682			−10.773	−22.115			−35.030***	332.55
			(−2.353)	(0.503)			(−1.067)	(−0.668)			(−2.992)	(4.666
Ground Lease			259.198	1380.62**			40.552*	174.434**			13.964	37.800
			(1.275)	(2.665)			(1.771)	(2.089)			(1.199)	(1.407
High Vacancy			55.956	135.185***			31.115	377.788*			−44.493***	−118.
			(1.403)	(3.863)			(0.982)	(1.734)			(−5.945)	(−5.0
Historical			−36.160	−254.12**			−29.927	−144.81**			−0.764	−23.8
			(−1.053)	(−2.303)			(−1.421)	(−2.358)			(−0.035)	(−0.3
Investor NNN			40.002***	58.877***			27.538***	15.866			19.300*	−23.2
			(5.840)	(3.073)			(6.065)	(1.528)			(1.836)	(−0.9
Land Contract			−53.000***	−62.880***			−61.847***	−148.78***			−49.444***	−24.3
			(−7.282)	(−6.084)			(−5.068)	(−2.873)			(−6.282)	(−0.8
Option Sale			29.027**	−1.241			9.427	−69.351			9.292	−49.2
			(2.345)	(−0.041)			(0.637)	(−1.359)			(0.507)	(−0.9
Partial Interest			77.330	2139.91***			−29.632*	−12.211			−16.252	−107.
			(0.589)	(2.998)			(−1.849)	(−0.429)			(−1.047)	(−1.7
Redevelopment			147.789*	524.912**			29.434	73.624**			−27.517***	−109.
			(1.886)	(2.318)			(1.240)	(2.426)			(−2.770)	(−4.6
REO			−62.954***	−100.62***			−49.703***	−211.33**			−57.506***	−92.7
			(−5.189)	(−4.855)			(−4.020)	(−2.586)			(−5.883)	(−3.1
Sale Leaseback			4.516	−38.647			30.346***	46.377			22.663***	−4.88
			(0.593)	(−1.512)			(2.847)	(0.761)			(3.245)	(−0.2
Shell Condition			64.789**	97.867**			12.399	−10.704			−39.457**	−99.8
R Square	0.114	0.120	0.151	0.563	0.106	0.113	0.131	0.290	0.209	0.219	0.233	0.415
Model N	8,460	8,460	8,460	8,460	8,476	8,476	8,476	8,476	8,579	8,579	8,579	8,579
ESTAR-N	10	10	10	10	24	24	24	24	899	899	899	899
Dual-N	5	5	5	5	4	4	4	4	286	286	286	286
LEED N	14	14	14	14	26	26	26	26	118	118	118	118
Prof Seller N	15	15	15	15	45	45	45	45	226	226	226	226
Prof Buyer N	18	18	18	18	60	60	60	60	771	771	771	771
Prof Both N	0	0	0	0	1	1	1	1	66	66	66	66
Market Fixed Effects	X	X	X	X	X	X	X	X	X	X	X	X
Sale Condition Controls			X	X			X	X			X	X
Weighting				X				X				X

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	>17,435 SF				Medium				>44,000 SF			
Variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**	**Model10**	**Model11**	**Mod**
			(2.192)	(2.152)			(0.860)	(−0.470)			(−2.388)	(−3.3
Short Sale			−45.184	−185.32			−68.970**	−232.95**			−39.445*	−98.2
			(−1.320)	(−1.449)			(−2.491)	(−2.610)			(−1.709)	(−2.6
Single Tenant			9.046**	17.013**			10.366*	57.492			4.487	9.959
			(2.646)	(2.267)			(1.864)	(1.469)			(1.474)	(1.000
Tenant Purchase			−8.276	−23.965			17.079**	−12.600			27.444***	74.342
			(−1.304)	(−1.294)			(2.421)	(−0.414)			(3.364)	(2.142
R Square	0.114	0.120	0.151	0.563	0.106	0.113	0.131	0.290	0.209	0.219	0.233	0.415
Model N	8,460	8,460	8,460	8,460	8,476	8,476	8,476	8,476	8,579	8,579	8,579	8,579
ESTAR-N	10	10	10	10	24	24	24	24	899	899	899	899
Dual-N	5	5	5	5	4	4	4	4	286	286	286	286
LEED N	14	14	14	14	26	26	26	26	118	118	118	118
Prof Seller N	15	15	15	15	45	45	45	45	226	226	226	226
Prof Buyer N	18	18	18	18	60	60	60	60	771	771	771	771
Prof Both N	0	0	0	0	1	1	1	1	66	66	66	66
Market Fixed Effects	X	X	X	X	X	X	X	X	X	X	X	X
Sale Condition Controls			X	X			X	X			X	X
Weighting				X				X				X

5.1. Model Overview

In the rental tables, Tables 5 and 6, the control variables behaved as expected. Size, when significant, tended to increase rent. Higher class buildings increased rent, and older buildings decreased rent. The R-Square in 20% range compared favorably to other fixed effect models (Robinson, 2013). Interestingly, in the size distributed model, Table 8, the R-Square for the lower sized buildings was much smaller, 11% than for the larger buildings, 25%. Since the expectation would be for homogeneity in the smaller sample, perhaps rents were driven more by location than by distinguishable building attributes.

In the sales tables, Tables 7 and 8, control variables were also largely as expected. Size tended to decrease the PSF price, consistent with smaller buildings selling at higher PSF prices. Although in the largest section, buildings over 280,563 square feet, size increased the PSF price. This indicates that after a tipping point, size more likely suggests premium locations demanding vertical construction, and PSF increases for the largest subsection. Building class increases PSF prices and age decreased it. Consistent with vertical build, excess land decreased PSF prices, suggesting less density around the buildings. The R-Sqaured for the sales models were also consistent with prior fixed effect models. However, weighting by sale price dramatically increased the R-Square to 50% or better. Adding more weight to the economically significant observations would naturally increase the R-Square, but the scale was larger than anticipated.

5.2. Energy Star

Rent (Tables 5 and 6)

The results divided by ESTAR thirds suggested that only the smallest third of ESTAR buildings, those less than 112,816 SF, possessed sustainability rental premiums. The largest size buildings had no premiums, and the middle buildings only showed premiums with no professional management control.

The smallest 1/3 of ESTAR buildings, those less than 112,816 SF, demonstrated premiums ranging from 3% to 4%. With the professional ownership control included, the premiums were closer to 3%. The results from the smallest size category, which consisted of 41,360 were strikingly similar to results of the whole population regression. The middle third showed no statistically significant premiums; the largest third of the ESTAR distribution also showed no evidence of statistically significant premiums.

Results from Table 6, divided by size, confirmed this trend. The smallest and middle third of the building distributions offered evidence of whopping 30% and 10% premiums respectively. Note that the smallest and middle third distribution by size contain a total of 216 Energy Star buildings, and that this entire population was contained in the smallest third of the Energy Star distribution in Table 5. The largest third of buildings, those over 53,758 SF, demonstrated no evidence of rent premiums, except in the weighted regressions.

The economically large premium in the smallest third of the size distribution derived from only 30 ESTAR buildings. Only 186 ESTAR buildings, the ESTAR building "N" in the middle third, provided evidence of the 10% premium. 91% of the ESTAR distribution, the 2,257 ESTAR buildings in the largest third of the overall building population, showed no statistically significant premium with the professional ownership control.

As discussed earlier, smaller buildings in a portfolio impact the economic returns much less than the larger buildings. The results here support examination of green premiums in a weighted or size distributed analysis.

Sales (Tables 7 and 8)

The ESTAR sales portfolio downloaded from CoStar consisted primarily of larger buildings, with the threshold for the bottom third at 151,775 SF. The results from regressions with market fixed effects shown in Table 7, divided by ESTAR, told a similar tale as the rent results. ESTAR sales premiums did not exist in the largest ESTAR buildings. However, the smallest and middle third of the ESTAR distribution showed PSF sales premiums ranging from $26 to $37 dollars. The premiums, although varying slightly in economic range, remained consistent with professional buyer/seller controls, and market controls.

However, weighting by price significantly impacted the estimated premiums, especially in the small and large portfolios. The premiums in the building sample under 151,775 SF disappeared when price weighted. Thus on an economic basis, the portfolio exhibited no premiums in the smallest section. In the largest, premiums actually came out negative and significant–a somewhat surprising result.

There are two likely explanation for the negative weighted premiums. The first was that the largest sales dominated the regression disproportionately given the small overall building N. Nine of the highest non-green sales totaled $13.9 Billion, which represented 8.6% and 4.8% of the by ESTAR and by Size distributions respectively. The second potential explanation is that, although fixed effect models better explain large national data sets, the results can become less consistent with market N's under 5-10 (Hox, 2010). Simple OLSDV regressions results[7] showed only one negative premium, ESTAR, and it was not significant.

In the middle portfolio, price weighting had no substantive effect. However, the variances of value and size, and consequent effect of weighting, were smallest in the middle section.

This general pattern of smaller and mid-size buildings showing premiums, but not the larger supports the superior management theory because the largest buildings, those over 280,000 SF will virtually require some full time staff to operate. The professional ownership control captured professional real estate owners, but the vast majority of office building larger than 280,000 SF will be professionally *managed* at a minimum. Thus, even though professional ownership was controlled for, the premiums in the smaller portions of the ESTAR building distribution might still be attributed somewhat to professional ownership.

Endogeneity in the ESTAR sample could be another possible explanation. Owners willing to go through the ESTAR certification process, and operating the building as such, might well exhibit superior site selection in purchasing as well. This theory

[7] Results in Appendix

could potentially explain the large buyer premiums shown throughout the data.

Surprisingly, the models distributed by building population, Table 6, showed mildly significant negative premiums for the smallest ESTAR buildings. However the significance washed away the with sale condition controls. Since only 10 ESTAR buildings were represented in that subsection, the findings could be building specific. An examination showed that several of the ESTAR buildings in the smallest sample had mean PSF sales prices less than their respective markets means. The findings more likely represented building specific than categorical implications.

The middle building distribution yielded high premiums of \$64 to \$77 PSF, but again only 24 sales. The vast majority, 899 sales or 96%, of the sales were in the largest third of the sale population.

In the largest portion, premiums ranging from \$22 to \$26 PSF were significant, but only at 10% with controls. However, the price weighted regression premiums were negative, with no statistical significance. This pattern supports the theory that smaller and middle buildings drove the premium. It also supports the theory that the economic impact of potential sustainability premiums needs to be examined when analyzing data sets.

5.3. LEED

Rent (Tables 5 and 6)

LEED certified buildings also generated consistent premiums among the the smaller sized buildings. In the sample split by ESTAR distribution, premiums of 13% were evidenced in the smallest third, but no statistically significant premiums in the middle and larger thirds.

In the regression split by building population, the 11 LEED buildings in the smallest third did not exhibit a premium, the middle 38 exhibited significant premiums of 12% to 15% when size weighted. The remaining 229, or 82%, showed 15%-16% premiums.

Sales (Tables 7 and 8)

LEED buildings relative to the ESTAR distribution were proportionally smaller with 93 of 168 buildings falling under 151,775 SF. LEED premiums remained significant, positive, and in a narrow range of \$64 to \$73 PSF across all the the smallest and medium sections in the Energy star distribution. The largest third showed only mildly significant premiums, and none in the model with professional ownership, but no sale condition controls. As with ESTAR, the weighted model was negative, but not statistically significant in this case.

In the size distributed model, the LEED buildings for the smallest two sections showed no significant premiums, except in the price weighted medium regression. However, only 14 and 26 buildings respectively, were in the two sections. The largest section held 286 LEED buildings and was statistically significant in the first three regressions.

Interestingly, the price weighted model again showed no statistically significant premiums, and this time with the bulk of the LEED buildings.

5.4. Dual Buildings

Rent (Tables 5 and 6)

By contrast, the Dual results showed no significance in the lower two portions, but did show significance in the largest third. However, since the population was split by ESTAR, the Dual population skewed heavily in the largest portion. Roughly 2/3 of the Dual population appeared in the largest size category. Size weighting did little to impact any of the dual premiums.

In the largest buildings, the premium was not significant with ownership control, and only significant, at the 10% level, without it.

The distribution of Dual buildings in the size distributed model put no buildings in the smallest section, only 7 of the buildings in the middle section, and the remaining 621 into the largest portion. No premiums were observed with the ownership controls. However, premiums of up to 9.8% were observed with no ownership control.

The findings for LEED premiums, but not Dual premiums, seemed counter intuitive at first. After all, Dual buildings by definition also were LEED buildings. The most plausible explanation relates to which buildings are more likely to be LEED only, and which Dual. When the U.S. Green Building Council (USGBC) launched LEED for Existing Buildings (LEED-EB) v2.0 in 2005, the minimum required Energy Star score was 60. Under v3.0, established in 2009, it is 69, and the proposal for LEED v2012 sets the minimum at 75. Thus many of the LEED-only buildings were likely to have achieved their certification pre-2009, as opposed to the Dual buildings.

The economically high premiums for the LEED only buildings may partly be a factor of the lease timing within the buildings. Office leases are typically 3-5 years, and many of the LEED only buildings may still be operating under leases signed during the 2000's real estate boom.

Sales (Tables 7 and 8)

Dual buildings skewed even larger relative to the ESTAR distribution, with 192 of the 295 buildings in the largest section. The middle section, consisting of 71 buildings, showed statistically significant premiums. However, neither the smallest 32 Dual buildings, nor the largest 192 showed any statistically significant premiums. Only the middle portion, containing 71 of the buildings demonstrated significant premiums.

In the price weighted regressions, like the ESTAR, the premiums were actually negative and significant. As with the ESTAR, the most plausible explanations were the heavily weighted higher sales, and potential fixed effect inconsistencies with the small N. Again, the OLSDV results[8] did not yield negative premiums.

In the building population model, premiums were negative for the small and middle sections, and significant for the middle. However, the Dual sample consisted of only 5 and 4 buildings respectively. As above, the findings were from only a small number of sale observations. Again, specific buildings sales were less than their market means and the findings are more likely building specific than categorical.

The larger sample, containing the remaining 286, did not show significant premi-

[8]Available in Appendix

ums in any of the models with ownership or condition controls. As in the prior model, price weighted premiums were negative and significant.

As with the ESTAR results, the most plausible explanation for the negative weighted premiums was that the largest sales dominated the regression disproportionately given the small overall building N. Similarly, winsorizing, reduced the scale, but not significance of the negative impact. A few large sales likely significantly impacted the overall weighted results.

5.5. Professional Ownership Related Variables

Rent (Tables 5 and 6)

Prof Owner was positive significant the two smaller portions of the ESTAR distribution, but not the largest. The most plausible reason for the lack of significance in the ESTAR distributed model would be that virtually all buildings over 224,000 SF would require professional management.

In the size distributed model, Prof Owner was positive significant in all specifications ranging from 4% to 5% premiums. As discussed earlier, the ownership variable dominated the ESTAR premiums in largest sample, where the vast majority of ESTAR buildings resided.

Overall the results strongly support the existence of the professional ownership premium. They also support the argument that professional ownership may be the active agent of the sustainability premiums.

Sales (Tables 7 and 8)

In the ESTAR size distributed model, Prof Buyer was positive significant in the smallest portion–contrary to expectations. One possible explanation is that despite the controls, buyers are acquiring premium properties in a market. The premium locations within a market may not be fully captured in the regressions, and the buyer premium could be attributed to the Prof Buyer's preference for those locations within a submarket.

The Prof Seller premium was significant positive in all specifications for the ESTAR distributed model, and further confirms the theory that superior negotiating power yields higher pricing. However, the seller premiums were not significant in the smallest building sizes in the size distributed model. The building size for the smallest section was only 17,435, and the Prof Seller N was only 15; the lack of significance was likely due to the small N and low professional ownership N.

The Prof Both variable was not significant in the ESTAR size distributed sample, although the sign of the coefficient was positive in most specifications. In the building size distributed sample the middle section did show significant negative, but the sample was only one building. The largest section, containing all but one of the Prof Both properties was similarly insignificant.

6. Robustness Checks

Quantile Regression

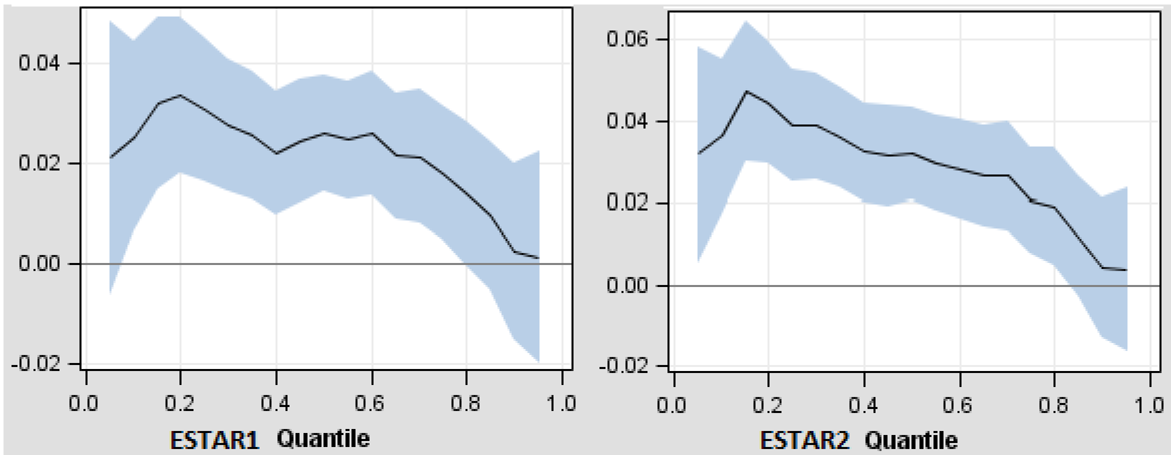
Quantile regression presents estimates of the dependent variables at various points over their conditional distributions. Its use here provided some insight regarding the behavior of property level characteristics across their distributions, and added to the body of knowledge regarding green real estate. Quantile was regression first introduced in its modern form by Koenker and Bassett Jr (1978).

The ESTAR results demonstrated a pattern showing that sustainability premiums were more evident on buildings in the lower portions of the distribution . Not only did the coefficients decrease as the rent increased, but their significance dissipated. The LEED and Dual variables followed a similar, but less pronounced pattern. Again, this provided some clues that size may be an issue to closely analyze in the green buildings. ESTAR graphical results are shown in Figure 2

In fact, few of the variables in the regression equation appeared to have uniform estimates across their conditional distributions, and the means in the macro regression may be misleading as consistent effects on the buildings. Figure 3 shows graphical results for LEED, Dual and Prof Owner.[9] The sales data results for the green and ownership variables are presented Tables 10.

[9]Graphical results for all variables are available from the author by request.

Figure 2: ESTAR Rent Quantile Results. Model 1 is with Prof Owner, and Model 2 without.



On the sales side, the impact of Energy Star seemed to decrease with PSF sales, while the impact of LEED and Dual seemed to increase with PSF sales. All three green variables also seemed to increase their effect with increases in PSF sales, but the increases were not as uniform.

As in the rent data, many of the variables did not have uniform estimates across their conditional distributions, suggesting an area of future research may be a detailed exploration of the size effect for all hedonic coefficients.

Results for the green variables and Prof Owner are presented in Table 9.

Figure 3: LEED, Dual and Prof Owner Rent Quantile Results. Model 1 is with Prof Owner, and Model 2 without.

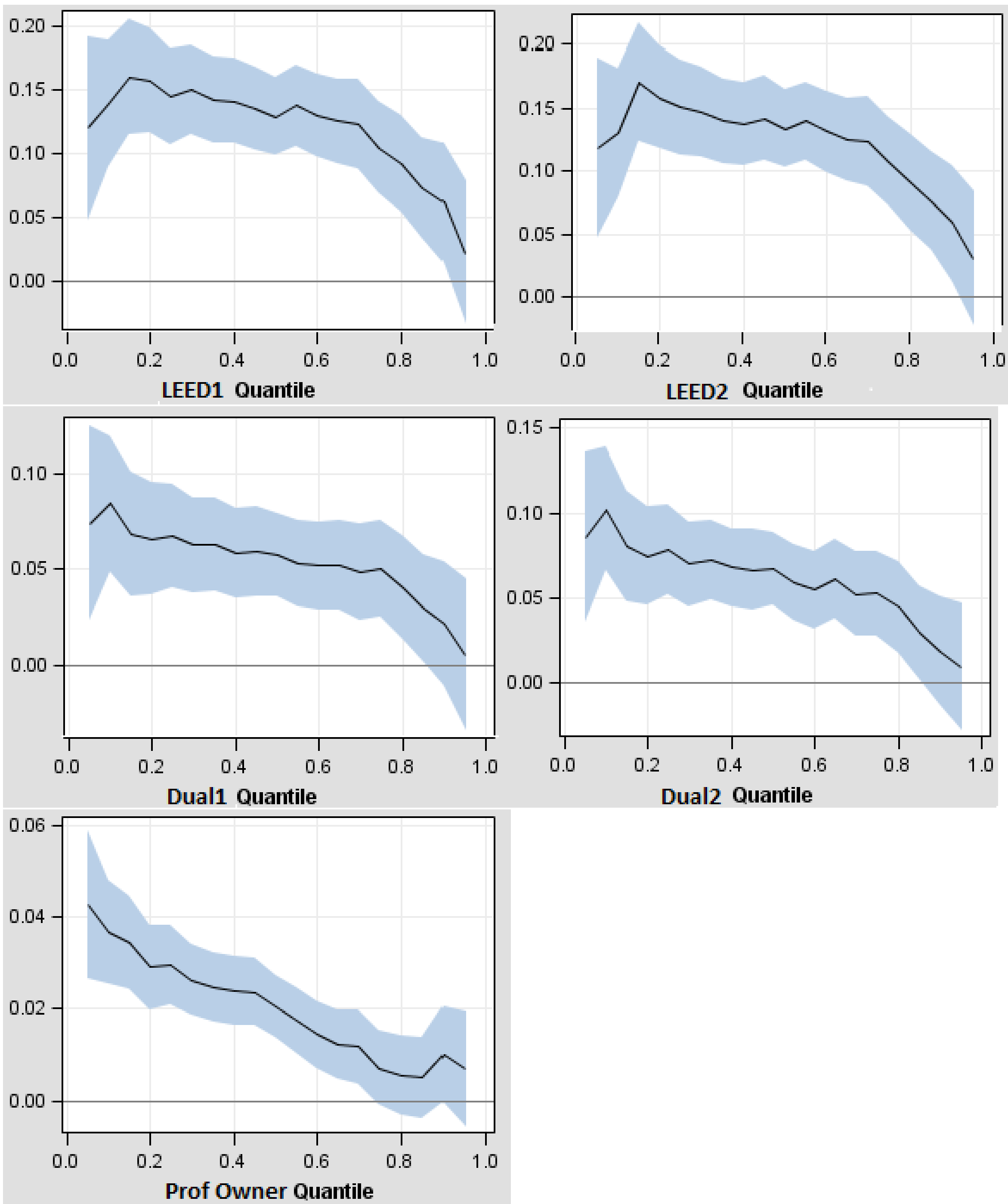


Table 9: This table presents results from quantile regressions on lnrent. In each quantile, two models are shown for the variables of interest. Models 1 includes the Prof Owner variable, while Model 2 does not. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	ESTAR		**LEED**		**Dual**		**Prof Owner**
Quantile	**Model1**	**Model2**	**Model1**	**Model2**	**Model1**	**Model2**	**Model1**
0.05	0.021	0.032**	0.120***	0.118***	0.074***	0.086***	0.043***
0.1	0.025***	0.036***	0.140***	0.130***	0.084***	0.102***	0.037***
0.15	0.032***	0.047***	0.160***	0.170***	0.068***	0.080***	0.034***
0.2	0.034***	0.044***	0.157***	0.158***	0.066***	0.075***	0.029***
0.25	0.031***	0.039***	0.145***	0.151***	0.068***	0.079***	0.030***
0.3	0.027***	0.039***	0.150***	0.147***	0.063***	0.070***	0.026***
0.35	0.026***	0.036***	0.142***	0.139***	0.063***	0.072***	0.025***
0.4	0.022***	0.032***	0.141***	0.137***	0.059***	0.068***	0.024***
0.45	0.024***	0.031***	0.135***	0.142***	0.059***	0.067***	0.024***
0.5	0.026***	0.032***	0.129***	0.134***	0.058***	0.067***	0.021***
0.55	0.025***	0.030***	0.137***	0.139***	0.053***	0.059***	0.018***
0.6	0.026***	0.028***	0.130***	0.131***	0.052***	0.055***	0.015***
0.65	0.021***	0.027***	0.125***	0.125***	0.052***	0.061***	0.012***
0.7	0.021***	0.026***	0.123***	0.124***	0.048***	0.052***	0.012***
0.75	0.018***	0.021***	0.104***	0.107***	0.050***	0.053***	0.007*
0.8	0.014*	0.019***	0.091***	0.090***	0.040***	0.045***	0.006
0.85	0.010	0.012	0.073***	0.076***	0.029**	0.030**	0.005
0.9	0.002	0.004	0.061***	0.058**	0.021	0.019	0.010*
0.95	0.001	0.004	0.022	0.030	0.005	0.009	0.007
Prof Owner	x		x		x		x

Table 10: This table presents results from quantile regressions on PSF. In each quantile, two models are shown for the variables of interest. . Models 1 and 2 include fixed effects by market, and Model 2 includes the Sale condition controls. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	ESTAR		LEED		Dual		Prof Buyer		Prof Seller		Prof Both	
Quantile	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
0.05	30.12***	29.77***	4.12	4.72	33.36***	31.09***	23.16***	23.26***	24.98***	30.87***	28.83***	52.87***
0.05	(15.97)	(16.74)	(1.00)	(1.21)	(10.44)	(10.32)	(12.30)	(13.10)	(8.17)	(10.72)	(4.63)	(9.01)
0.1	28.72***	29.80***	9.58**	10.73**	36.21***	37.23***	21.78***	22.55***	31.62***	32.30***	51.27***	50.02***
0.1	(15.03)	(15.29)	(2.29)	(2.52)	(11.19)	(11.27)	(11.42)	(11.58)	(10.22)	(10.23)	(8.13)	(7.78)
0.15	27.80***	27.79***	5.96	7.67*	40.44***	41.55***	23.66***	22.35***	32.84***	33.45***	45.67***	46.82***
0.15	(13.86)	(14.40)	(1.36)	(1.82)	(11.90)	(12.70)	(11.82)	(11.59)	(10.11)	(10.70)	(6.90)	(7.35)
0.2	27.31***	26.38***	9.70**	15.05***	46.64***	45.39***	20.55***	22.50***	26.68***	28.62***	37.43***	42.10***
0.2	(13.41)	(13.56)	(2.18)	(3.54)	(13.52)	(13.77)	(10.11)	(11.59)	(8.09)	(9.09)	(5.57)	(6.56)
0.25	28.44***	27.96***	17.88***	22.99***	47.80***	48.60***	23.93***	23.30***	28.00***	26.63***	33.20***	34.15***
0.25	(13.75)	(14.06)	(3.96)	(5.29)	(13.64)	(14.42)	(11.60)	(11.74)	(8.36)	(8.27)	(4.86)	(5.21)
0.3	31.97***	30.85***	28.28***	28.43***	49.96***	51.90***	21.86***	22.45***	26.94***	25.41***	34.84***	33.65***
0.3	(14.72)	(14.93)	(5.96)	(6.30)	(13.58)	(14.82)	(10.08)	(10.88)	(7.66)	(7.59)	(4.86)	(4.94)
0.35	31.03***	28.50***	27.83***	29.96***	54.34***	50.13***	21.83***	22.36***	28.14***	26.46***	37.90***	34.43***
0.35	(15.42)	(13.96)	(6.33)	(6.72)	(15.93)	(14.50)	(10.87)	(10.97)	(8.63)	(8.01)	(5.70)	(5.11)
0.4	30.36***	29.12***	30.89***	39.18***	52.45***	52.72***	21.39***	21.40***	28.05***	26.87***	49.30***	55.44***
0.4	(14.47)	(13.79)	(6.74)	(8.50)	(14.75)	(14.74)	(10.21)	(10.16)	(8.25)	(7.86)	(7.12)	(7.97)
0.45	28.97***	27.74***	35.54***	37.50***	52.98***	50.74***	22.09***	22.78***	29.36***	25.66***	57.14***	60.81***
0.45	(12.90)	(12.79)	(7.24)	(7.92)	(13.92)	(13.81)	(9.85)	(10.52)	(8.07)	(7.31)	(7.71)	(8.50)
0.5	27.37***	26.49***	47.61***	46.06***	51.69***	55.42***	22.21***	21.55***	29.21***	26.94***	61.62***	57.59***
0.5	(11.50)	(11.11)	(9.16)	(8.85)	(12.82)	(13.72)	(9.35)	(9.05)	(7.58)	(6.98)	(7.85)	(7.32)
0.55	27.31***	26.05***	48.79***	50.92***	56.38***	55.76***	22.74***	24.07***	29.37***	25.91***	58.59***	60.24***
0.55	(11.38)	(10.92)	(9.31)	(9.78)	(13.87)	(13.81)	(9.50)	(10.11)	(7.56)	(6.71)	(7.40)	(7.66)
0.6	28.22***	28.39***	69.14***	67.20***	57.48***	55.63***	23.28***	24.72***	29.61***	27.04***	105.95***	107.64***
0.6	(10.67)	(11.29)	(11.96)	(12.24)	(12.82)	(13.06)	(8.82)	(9.85)	(6.91)	(6.64)	(12.13)	(12.98)
0.65	28.41***	28.34***	85.54***	84.65***	63.51***	59.53***	23.32***	25.50***	29.79***	26.81***	104.89***	108.01***
0.65	(10.60)	(11.12)	(14.60)	(15.21)	(13.98)	(13.79)	(8.71)	(10.02)	(6.86)	(6.50)	(11.85)	(12.85)
0.7	29.86***	28.88***	110.27***	99.55***	64.75***	62.21***	27.55***	26.78***	29.54***	25.03***	118.83***	114.40***
0.7	(9.93)	(9.93)	(16.78)	(15.68)	(12.71)	(12.63)	(9.18)	(9.23)	(6.07)	(5.32)	(11.97)	(11.93)
0.75	29.58***	30.78***	107.38***	103.75***	63.98***	61.60***	34.48***	30.97***	33.51***	31.83***	108.80***	104.73***
0.75	(9.05)	(10.14)	(15.04)	(15.65)	(11.56)	(11.98)	(10.57)	(10.22)	(6.33)	(6.48)	(10.09)	(10.46)
0.8	28.22***	28.46***	131.36***	124.74***	68.82***	66.73***	34.73***	35.73***	39.13***	30.94***	125.45***	121.90***
0.8	(7.72)	(8.04)	(16.45)	(16.14)	(11.12)	(11.13)	(9.52)	(10.12)	(6.61)	(5.40)	(10.40)	(10.45)
0.85	23.62***	26.68***	125.50***	121.47***	72.08***	75.02***	38.64***	40.14***	48.53***	48.77***	113.80***	110.23***
0.85	(6.03)	(7.04)	(14.66)	(14.69)	(10.86)	(11.69)	(9.88)	(10.62)	(7.65)	(7.95)	(8.80)	(8.83)
0.9	20.18***	19.77***	130.90***	113.78***	64.42***	66.71***	42.36***	43.91***	56.83***	61.30***	102.38***	100.19***
0.9	(4.13)	(4.39)	(12.25)	(11.56)	(7.77)	(8.74)	(8.68)	(9.76)	(7.17)	(8.40)	(6.34)	(6.74)
0.95	25.95***	25.22***	151.03***	153.58***	64.99***	73.50***	39.20***	47.05***	39.20***	47.05***	67.67***	88.30***
0.95	(3.58)	(4.03)	(9.53)	(11.24)	(5.29)	(6.93)	(5.41)	(7.53)	(5.41)	(7.53)	(2.83)	(4.28)
Sale Condition Controls		X		X		X		x		x		x

7. Conclusion

This paper presented arguments that real estate portfolios should be examined from an economic perspective in addition to an equal weight. Assuming that every observation maintains an equal weight could lead to economically unjustified findings and econometrically biased results. Real Estate investments require capital, as do any financial investments, and returns should be examined from a value weighted perspective. Additionally, the large variance of properties in a national database could produce inconsistent estimators in a regression.

The extant literature in sustainable real estate found uniform support for green market premiums (Eichholtz et al., 2010; Fuerst and McAllister, 2011; Miller et al., 2008; Pivo and Fisher, 2010; Wiley et al., 2010). Prior authors failed to consider well-established investment literature (Brown and Warner, 1980; Fama, 1998; Fama and French, 1988) findings that the assumption of equal weights may lead to biased results. At a minimum the extant literature suggests examining both equal and value weight portfolios.

The finding in this article also strongly supported the presence of a professional management premium, and the possibility that professional management represents the agent of sustainability premiums. These results showing ownership rental premiums across size categories support and are consistent with the findings in Robinson (2013). The key results have been summarized in Tables 11 and 12 for rental and sales data respectively.

Table 11: This table summarizes the results from the rent regressions with market fixed effects in Tables 5 and 6. All variables significant at a 5% or better level were **bolded**. Results for each size bracket are from the first and third models in that bracket; each included the professional ownership control, and the latter was weighted by size. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	ESTAR by Thirds Table 5					
	<112,816 SF		<Middle>		>224,555 SF	
	Model1	**Model3**	**Model5**	**Model7**	**Model9**	**Model11**
ESTAR	**0.042****	**0.052****	0.014	0.014	0.022	0.041
LEED	**0.137*****	**0.145*****	**0.160*****	**0.166*****	0.112	**0.151*****
Dual	0.014	−0.005	0.069	0.064	0.086	0.100*
Prof Owner	**0.049*****	**0.050*****	**0.051****	**0.053****	**0.074*****	**0.081*****
	Size by Thirds Table 6					
	< 21,212 SF		<Middle>		> 53,758 SF	
	Model1	**Model3**	**Model5**	**Model7**	**Model9**	**Model11**
ESTAR	**0.300****	**0.301****	**0.099*****	**0.099*****	0.030	0.030
LEED	0.069	0.070	**0.126****	**0.123****	**0.151*****	**0.151*****
Dual	0.000	0.000	0.004	0.006	0.061	0.063
Prof Owner	**0.046****	**0.046****	**0.057*****	**0.058*****	**0.056*****	**0.056*****
Weighted		X		X		X

Table 12: This table summarizes the results from the sales regressions with market fixed effects in Tables 7 and 8. All variables significant at a 5% or better level were **bolded**. Results for each size bracket are from the third and fourth models in that bracket; each included the professional ownership controls and sale condition controls, the latter was weighted by sale price. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	ESTAR by Thirds Table 7					
	<151,775 SF		<Middle>		< 280,563 SF	
	Model3	**Model4**	**Model7**	**Model8**	**Model11**	**Model12**
ESTAR	$\mathbf{27.926}^{***}$	10.096	$\mathbf{34.758}^{***}$	$\mathbf{30.648}^{***}$	-7.369	$\mathbf{-99.428}^{***}$
LEED	$\mathbf{66.177}^{**}$	$\mathbf{71.302}^{**}$	$\mathbf{73.117}^{**}$	$\mathbf{83.853}^{***}$	58.835^{*}	-16.516
Dual	25.123	-9.148	$\mathbf{62.386}^{***}$	$\mathbf{48.626}^{***}$	2.219	$\mathbf{-108.94}^{***}$
Prof Seller	$\mathbf{62.935}^{***}$	$\mathbf{34.438}^{***}$	18.866	12.873	7.582	-12.110
Prof Buyer	$\mathbf{41.561}^{***}$	$\mathbf{69.864}^{***}$	$\mathbf{85.504}^{***}$	$\mathbf{96.476}^{***}$	$\mathbf{77.083}^{***}$	52.376^{*}
Prof Both	52.176	-19.032	34.523	2.529	$\mathbf{115.346}^{**}$	$\mathbf{192.002}^{**}$
	Size by Thirds Table 8					
	Model3	**Model4**	**Model7**	**Model8**	**Model11**	**Model12**
	<17,435 SF		<Middle>		>44,019 SF	
ESTAR	-30.937	$\mathbf{-78.067}^{***}$	$\mathbf{64.236}^{**}$	88.994^{*}	22.162^{*}	$\mathbf{-63.981}^{**}$
LEED	13.209	112.383	57.404	$\mathbf{131.717}^{**}$	$\mathbf{81.229}^{***}$	11.486
Dual	-33.971	-141.42	-56.240^{*}	$\mathbf{-66.741}^{**}$	35.179	$\mathbf{-78.617}^{**}$
Prof Seller	$\mathbf{212.689}^{***}$	344.407	$\mathbf{125.297}^{***}$	272.399	$\mathbf{28.473}^{***}$	0.782
Prof Buyer	22.199	5.054	28.348^{*}	-6.306	$\mathbf{68.176}^{***}$	$\mathbf{60.985}^{***}$
Prof Both	0.000	0.000	$\mathbf{-130.02}^{***}$	$\mathbf{-491.96}^{**}$	$\mathbf{78.004}^{**}$	$\mathbf{150.115}^{**}$
Weighted		X		X		X

The results from the empirical tests demonstrated clear patterns in the distribution of ESTAR rental premiums. The smaller buildings drove the premiums, while the larger buildings provided no evidence of sustainability premiums. Since nearly half of the buildings over 225,000 SF achieved some level of green designation, perhaps the green designation is becoming more of an expectation in that segment. Considering the distribution of buildings, it was not surprising that the largest buildings rents appeared unaffected by any green designation. Perhaps the largest buildings, which tend to be located in "A" locations, achieve market premiums based on location, and green designations are of little incremental effect. In addition, the findings here of 4% to 5% premiums for only the smallest ESTAR buildings are economically realistic.

LEED premiums were consistently found across most size categories, although Dual ESTAR/LEED buildings demonstrated limited significance. This finding supported the theory that LEED building premiums may have been driven by the timing of their lease-up during the last real estate boom, and not necessarily by their green designations.

Similar to the rental database, the largest building sales regressions showed that ESTAR held no premiums for the largest buildings. The economic impact clearly shows in the sales premiums. An investment choice to purchase a $100 Million dollar buildings represents a drastically different choice than to purchase 10 unique $10 Million dollar buildings. In fact, weighting by price had dramatic effect in most of the size categories. While some sustainability premiums were found, the economic impact of those was less for the smaller size categories.

Only LEED stand-alone buildings seemed to hold cross all size categories. However, this could be a legacy of lease contracts signed during the peak of the last real estate cycle. Dual buildings showed premiums in the mid-size buildings, but the bulk of their distribution was in the largest section, which showed no premiums.

The quantile regression results confirmed this pattern; they clearly showed variations along the conditional means. Each of the premiums shown by the sustainability categories tailed off at the upper end of their distributions. Not only does the quantile regression support the findings that stratified size and economic attributes effect premium analysis, but they raise questions regarding the overall viability of OLSDV regression as an efficient tool to research a broad swath of buildings. OLSDV assumes some level of consistent variance around the mean, but as conditional distributions vary, the reliability of those estimators was called into question.

This paper provided evidence that potential market premiums, at least specific to green premiums, were size and/or price dependent. It demonstrated clear evidence that value weighting alters regression results in real estate sales portfolios.

Future research could explore the size and price effect in more detail and examine the specific demand and supply factors that drive the existence or lack of premiums. This paper offers a additional information into the size effects of buildings, and provides a basis for future research in real estate value weighting.

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8. Appendix

Table A: This table lists the variables used in this paper, and their corresponding field in the CoStar database.

Variable	Definition	CoStar Field Rent	Costar Field Sales
ESTAR	1 if Building is Energy Star Certified, but not Dual	energy_star	energy_star
LEED	1 if Building is LEED Certified, but not Dual	leed_certified	leed_certified
Dual	1 if Building is both ESTAR and LEED		
lnrent	Natural Log of Average Weighted Building Rent	average_weighted_rent	
PSF	Per Square Foot Sales Price		Sale_price/bldg_sf
lnsize	Natural Log of Size	rentable_building_area	bldg_sf
NNN	1 if lease type = Triple Net	services	
FSG	1 if lease type = Full Service Gross	services	
Percent Leased	Percentage of building leased Q4 2011	percent_leased	
ren_within_10	1 if building was renovated from 2001 forward	year_renovated	
lnland	Natural Log of land		land_area_sf
stories	Number of Stories in Building	number_of_stories	number_of_floors
A_Class	1 if Building is "A" Class	building_class	building_class
B_Class	1 if Building is "B" Class	building_class	building_class
amenity	1 if Building contains any amenities like, Bank, Fitness Center, etc.	Amenities	Amenities
age100	1 if Age >= 100	2011-year_built	2011-year_built
age75	1 if 75>= Age >100	2011-year_built	2011-year_built
age50	1 if 50>= Age >75	2011-year_built	2011-year_built
age40	1 if 40>= Age >40	2011-year_built	2011-year_built
age30	1 if 30>= Age >30	2011-year_built	2011-year_built
age20	1 if 30>= Age >20	2011-year_built	2011-year_built
age15	1 if 15>= Age >15	2011-year_built	2011-year_built
age10	1 if 10>= Age >10	2011-year_built	2011-year_built
age5	1 if 5>= Age	2011-year_built	2011-year_built
year2002	1 If sale occurred during this year		sale_date
year2003	1 If sale occurred during this year		sale_date
year2004	1 If sale occurred during this year		sale_date
year2005	1 If sale occurred during this year		sale_date
year2006	1 If sale occurred during this year		sale_date
year2007	1 If sale occurred during this year		sale_date
year2008	1 If sale occurred during this year		sale_date
year2009	1 If sale occurred during this year		sale_date
year2010	1 If sale occurred during this year		sale_date
year2011	1 If sale occurred during this year	sale_date	
submarket	Submarket for physical building	submarket_cluster	
Market	Market for physical building	market_name	market
Prof Owner	If number of owner addresses meets criteria from Section 4	owner_address	from rent data
Prof Seller	If building seller corresponds to Prof Owner in rent data set		
Prof Buyer	If building buyer corresponds to Prof Owner in rent data set		
Prof Both	If building buyer and seller correspond to Prof Owner in rent data set		

Table B: This table presents results from regressions on lnrent of the building population split into thirds by size. In each size category, results are presented first with and without the Prof Owner variable in an OLS regression with submarket dummies included. Models 1 and 2,5 and 6,9 and 10 are of this form for their respective size group. Next results are presented with the same regression weighted by lnsize, both with and without the Prof Owner variable.***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	Smallest 1/3 Buildings > 21,212 SF				**Mid 1/3 Buildings**				**Largest 1/3 Buildings > 53,758 SF**			
Variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**	**Model10**	**Model11**	**Model12**
Intercept	2.782***	2.781***	2.783***	2.782***	2.880***	2.765***	2.880***	2.762***	2.846***	2.792***	2.841***	2.787***
	(16.554)	(16.547)	(16.559)	(16.552)	(27.921)	(27.312)	(27.960)	(27.332)	(42.552)	(42.241)	(42.912)	(42.610)
ESTAR	0.125**	0.128**	0.123**	0.126**	0.040**	0.053***	0.040**	0.053***	0.016***	0.020***	0.016***	0.019***
	(2.205)	(2.269)	(2.170)	(2.232)	(2.015)	(2.714)	(2.051)	(2.759)	(2.790)	(3.489)	(2.807)	(3.487)
LEED	0.042	0.042	0.041	0.041	0.132***	0.133***	0.131***	0.132***	0.051***	0.052***	0.049***	0.050***
	(0.475)	(0.478)	(0.465)	(0.468)	(3.023)	(3.038)	(3.023)	(3.037)	(3.233)	(3.297)	(3.202)	(3.268)
Dual	0.000	0.000	0.000	0.000	−0.034	−0.030	−0.033	−0.029	0.045***	0.049***	0.047***	0.050***
	(.)	(.)	(.)	(.)	(−0.339)	(−0.304)	(−0.333)	(−0.298)	(4.458)	(4.887)	(4.773)	(5.203)
Prof Owner	0.008		0.008		0.025***		0.025***		0.012***		0.012***	
	(0.610)		(0.604)		(3.666)		(3.696)		(3.008)		(2.928)	
lnsize	0.021**	0.021**	0.021**	0.021**	0.023***	0.026***	0.023***	0.026***	0.035***	0.036***	0.036***	0.037***
	(2.079)	(2.095)	(2.072)	(2.089)	(2.856)	(3.173)	(2.861)	(3.180)	(8.189)	(8.449)	(8.512)	(8.766)
age100	−0.126***	−0.126***	−0.127***	−0.127***	−0.197***	−0.196***	−0.197***	−0.197***	−0.244***	−0.243***	−0.244***	−0.243***
	(−7.961)	(−7.957)	(−8.002)	(−7.998)	(−12.945)	(−12.870)	(−12.973)	(−12.897)	(−18.214)	(−18.143)	(−18.164)	(−18.094)
age75	−0.127***	−0.127***	−0.127***	−0.127***	−0.188***	−0.187***	−0.188***	−0.187***	−0.255***	−0.254***	−0.252***	−0.252***
	(−8.401)	(−8.394)	(−8.402)	(−8.395)	(−13.981)	(−13.857)	(−13.999)	(−13.874)	(−21.349)	(−21.258)	(−21.212)	(−21.122)
age50	−0.183***	−0.183***	−0.184***	−0.183***	−0.199***	−0.198***	−0.199***	−0.197***	−0.251***	−0.250***	−0.253***	−0.252***
	(−14.988)	(−14.981)	(−14.991)	(−14.984)	(−15.433)	(−15.312)	(−15.409)	(−15.286)	(−18.372)	(−18.295)	(−18.507)	(−18.433)
age40	−0.146***	−0.146***	−0.146***	−0.146***	−0.180***	−0.178***	−0.180***	−0.179***	−0.253***	−0.252***	−0.253***	−0.252***
	(−13.143)	(−13.136)	(−13.157)	(−13.150)	(−15.929)	(−15.768)	(−15.960)	(−15.796)	(−23.020)	(−22.888)	(−23.048)	(−22.917)
age30	−0.138***	−0.138***	−0.138***	−0.138***	−0.179***	−0.177***	−0.179***	−0.178***	−0.237***	−0.235***	−0.236***	−0.235***
	(−15.340)	(−15.330)	(−15.360)	(−15.350)	(−19.594)	(−19.452)	(−19.603)	(−19.460)	(−24.971)	(−24.815)	(−24.877)	(−24.723)
age20	−0.126***	−0.126***	−0.127***	−0.126***	−0.158***	−0.156***	−0.159***	−0.157***	−0.209***	−0.208***	−0.209***	−0.207***
	(−15.559)	(−15.548)	(−15.575)	(−15.565)	(−19.286)	(−19.072)	(−19.311)	(−19.095)	(−24.841)	(−24.657)	(−24.748)	(−24.570)
R Square	0.501	0.501	0.501	0.501	0.577	0.576	0.578	0.577	0.729	0.728	0.732	0.731
Model N	16, 186	16, 186	16, 186	16, 186	16, 219	16, 219	16, 219	16, 219	16, 225	16, 225	16, 225	16, 045
ESTAR-N	30	30	30	30	186	186	186	186	2,257	2,257	2,257	2,257
LEED-N	11	11	11	11	38	38	38	38	229	229	229	229
Dual-N	0	0	0	0	7	7	7	7	621	621	621	621
Non-Eco-N	16,203	16,203	16,203	16,203	16,014	16,014	16,014	16,014	13,137	13,137	13,137	13,137
Prof Owner	568	568	568	568	1,872	1,872	1,872	1,872	5,884	5,884	5,884	5,884
Weighting			X	X			X	X			X	X

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	Smallest 1/3 Buildings				Mid 1/3 Buildings				Largest 1/3 Buildings			
Variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**	**Model10**	**Model11**	**Model12**
age15	-0.074^{***}	-0.074^{***}	-0.074^{***}	-0.074^{***}	-0.077^{***}	-0.075^{***}	-0.077^{***}	-0.075^{***}	-0.153^{***}	-0.152^{***}	-0.155^{***}	-0.153^{***}
	(-5.062)	(-5.044)	(-5.038)	(-5.021)	(-5.643)	(-5.487)	(-5.636)	(-5.479)	(-12.210)	(-12.067)	(-12.305)	(-12.167)
age10	-0.048^{***}	-0.048^{***}	-0.048^{***}	-0.048^{***}	-0.085^{***}	-0.084^{***}	-0.085^{***}	-0.084^{***}	-0.145^{***}	-0.143^{***}	-0.145^{***}	-0.143^{***}
	(-4.474)	(-4.471)	(-4.472)	(-4.469)	(-8.272)	(-8.150)	(-8.310)	(-8.187)	(-15.417)	(-15.247)	(-15.290)	(-15.127)
age5	-0.000	0.000	0.000	0.000	-0.020^{**}	-0.021^{**}	-0.021^{**}	-0.021^{**}	-0.094^{***}	-0.094^{***}	-0.094^{***}	-0.093^{***}
	(-0.001)	(0.000)	(0.004)	(0.005)	(-2.142)	(-2.181)	(-2.175)	(-2.217)	(-9.972)	(-9.928)	(-9.901)	(-9.860)
Renovated	0.055^{***}	0.055^{***}	0.055^{***}	0.055^{***}	0.043^{***}	0.042^{***}	0.043^{***}	0.042^{***}	0.023^{***}	0.023^{***}	0.022^{***}	0.022^{***}
	(4.826)	(4.825)	(4.837)	(4.836)	(5.272)	(5.186)	(5.273)	(5.187)	(4.078)	(4.056)	(3.957)	(3.938)
Percent Leased	0.001^{***}	0.001^{***}	0.001^{***}	0.001^{***}	0.001^{***}	0.001^{***}	0.001^{***}	0.001^{***}	0.001^{***}	0.001^{***}	0.001^{***}	0.001^{***}
	(11.012)	(11.014)	(11.017)	(11.019)	(12.155)	(12.065)	(12.167)	(12.075)	(9.463)	(9.404)	(9.418)	(9.361)
stories	0.012^{***}	0.011^{***}	0.012^{***}	0.012^{***}	0.013^{***}	0.013^{***}	0.013^{***}	0.013^{***}	0.001^{***}	0.001^{***}	0.001^{***}	0.001^{***}
	(3.758)	(3.738)	(3.778)	(3.758)	(7.663)	(7.613)	(7.698)	(7.652)	(3.526)	(3.498)	(3.386)	(3.361)
A Class	0.245^{**}	0.245^{**}	0.244^{**}	0.244^{**}	0.229^{***}	0.230^{***}	0.229^{***}	0.230^{***}	0.255^{***}	0.257^{***}	0.255^{***}	0.257^{***}
	(2.056)	(2.059)	(2.075)	(2.078)	(20.341)	(20.433)	(20.465)	(20.557)	(28.778)	(28.970)	(28.629)	(28.817)
B Class	0.097^{***}	0.097^{***}	0.097^{***}	0.097^{***}	0.117^{***}	0.118^{***}	0.118^{***}	0.118^{***}	0.141^{***}	0.142^{***}	0.142^{***}	0.142^{***}
	(18.551)	(18.571)	(18.568)	(18.587)	(21.310)	(21.379)	(21.312)	(21.378)	(18.274)	(18.306)	(18.160)	(18.190)
NNN	-0.058^{***}	-0.058^{***}	-0.058^{***}	-0.058^{***}	-0.113^{***}	-0.114^{***}	-0.114^{***}	-0.114^{***}	-0.152^{***}	-0.152^{***}	-0.152^{***}	-0.152^{***}
	(-9.479)	(-9.483)	(-9.499)	(-9.503)	(-18.445)	(-18.442)	(-18.509)	(-18.509)	(-23.143)	(-23.137)	(-23.066)	(-23.059)
FSG	0.092^{***}	0.092^{***}	0.093^{***}	0.093^{***}	0.098^{***}	0.098^{***}	0.098^{***}	0.098^{***}	0.108^{***}	0.108^{***}	0.109^{***}	0.109^{***}
	(16.241)	(16.245)	(16.294)	(16.298)	(18.572)	(18.482)	(18.571)	(18.478)	(20.319)	(20.201)	(20.515)	(20.399)
Amenity	0.004	0.004	0.004	0.004	0.003	0.004	0.003	0.004	0.010^{*}	0.010^{**}	0.010^{*}	0.010^{**}
	(0.864)	(0.873)	(0.836)	(0.845)	(0.702)	(0.842)	(0.702)	(0.845)	(1.941)	(1.979)	(1.932)	(1.970)
R Square	0.501	0.501	0.501	0.501	0.577	0.576	0.578	0.577	0.729	0.728	0.732	0.731
Model N	16, 186	16, 186	16, 186	16, 186	16, 219	16, 219	16, 219	16, 219	16, 225	16, 225	16, 225	16, 045
ESTAR-N	30	30	30	30	186	186	186	186	2,257	2,257	2,257	2,257
LEED-N	11	11	11	11	38	38	38	38	229	229	229	229
Dual-N	0	0	0	0	7	7	7	7	621	621	621	621
Non-Eco-N	16,203	16,203	16,203	16,203	16,014	16,014	16,014	16,014	13,137	13,137	13,137	13,137
Prof Owner	568	568	568	568	1,872	1,872	1,872	1,872	5,884	5,884	5,884	5,884
Weighting			X	X			X	X			X	X

Table C: This table presents results from regressions on lnrent of the building population split into thirds by the size of Energy Star (ESTAR) buildings. The smallest third contains the smallest third of the Energy Star buildings, and all builings in the same size category. In this regressions the ESTAR N is uniformly distributed, but the building population is skewed. In each size category, results are presented first with and without the Prof Owner variable in an OLS regression with submarket dummies included. Models 1,2,5,6,9,10 are of this form for their respective size group. Next results are presented with the same regression weighted by lnsize, both with and without the Prof Owner variable.***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	Smallest 1/3 ESTAR Buildings (<125,000 SF)				**Mid 1/3 ESTAR Buildings**				**Largest 1/3 (>256,150 SF)**			
Variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**	**Model10**	**Model11**	**Model12**
ESTAR	37.117***	21.015***	22.352***	12.513*	33.862***	31.754***	31.704***	32.042***	8.814	14.501	13.488	0.417
	(5.162)	(3.364)	(3.598)	(1.768)	(4.180)	(4.477)	(4.509)	(3.908)	(0.738)	(1.370)	(1.269)	(0.033)
LEED	69.178***	62.803***	62.871***	77.916***	71.291***	56.162***	60.646***	72.862***	78.554**	34.271	31.429	28.535
	(5.380)	(5.675)	(5.711)	(5.160)	(3.288)	(3.047)	(3.268)	(3.792)	(2.511)	(1.275)	(1.173)	(1.093)
Dual	27.137	18.400	18.623	−20.741	63.001***	48.201***	44.495***	45.314***	16.631	23.305*	20.549	0.834
	(1.258)	(0.993)	(1.010)	(−0.977)	(4.170)	(3.683)	(3.431)	(3.392)	(1.171)	(1.814)	(1.597)	(0.054)
Prof Buyer		56.406***	57.235***	52.438***		10.016	10.615	5.691		0.306	−0.120	−21.820*
		(10.659)	(10.863)	(8.142)		(1.251)	(1.338)	(0.627)		(0.027)	(−0.011)	(−1.729)
Prof Seller		40.244***	37.967***	71.968***		61.590***	57.811***	66.334***		52.514***	48.005**	11.621
		(5.061)	(4.800)	(6.697)		(4.280)	(4.062)	(4.552)		(2.617)	(2.386)	(0.576)
Prof Both		54.551**	56.645***	33.888		17.652	17.154	−14.048		64.156**	66.996**	80.936***
		(2.491)	(2.602)	(1.454)		(0.781)	(0.767)	(−0.591)		(2.162)	(2.275)	(2.780)
Intercept	357.583***	309.908***	313.133***	729.289***	529.275**	379.755*	424.725**	884.901***	211.740	202.838	161.998	884.956***
	(25.507)	(19.257)	(19.486)	(20.681)	(2.375)	(1.938)	(2.191)	(3.669)	(1.275)	(1.302)	(1.028)	(4.420)
lnsize	−18.383***	−27.882***	−28.299***	−68.183***	−6.782	−11.858	−14.752	−47.073**	28.629**	0.809	5.356	−56.254***
	(−10.577)	(−18.368)	(−18.648)	(−22.465)	(−0.366)	(−0.742)	(−0.934)	(−2.426)	(2.000)	(0.064)	(0.422)	(−3.807)
age100	30.948***	9.866**	9.012**	21.182**	−5.780	−27.346	−29.947	−7.082	−47.579	−103.01***	−103.26***	−43.208
	(6.109)	(2.196)	(2.006)	(2.042)	(−0.253)	(−1.359)	(−1.474)	(−0.295)	(−1.275)	(−3.190)	(−3.131)	(−1.177)
age75	19.138***	−8.091**	−8.546**	−38.195***	−29.106	−43.934**	−49.474***	−10.681	−83.654***	−156.45***	−161.72***	−216.67***
	(4.100)	(−1.969)	(−2.080)	(−3.907)	(−1.488)	(−2.536)	(−2.844)	(−0.488)	(−2.827)	(−6.012)	(−6.045)	(−7.210)
age50	8.103*	1.071	1.280	30.815***	−78.639***	−64.633***	−64.973***	−105.04***	−102.07***	−167.52***	−168.01***	−130.34***
	(1.825)	(0.277)	(0.331)	(3.105)	(−3.601)	(−3.438)	(−3.459)	(−4.141)	(−3.249)	(−6.107)	(−5.956)	(−4.029)
R Square	0.112	0.348	0.357	0.417	0.293	0.525	0.548	0.608	0.246	0.505	0.526	0.602
Model N	41, 266	41, 266	41, 266	41, 266	4, 542	4, 542	4, 542	4, 542	2, 822	2, 822	2, 822	2, 822
ESTAR-N	825	825	825	825	824	824	824	824	824	824	824	824
LEED-N	114	114	114	114	82	82	82	82	82	82	82	82
Dual-N	68	68	68	68	147	147	147	147	413	413	413	413
Non-Eco-N	40,353	40,353	40,353	40,353	3,577	3,577	3,577	3,577	1,506	1,506	1,506	
Prof Owner	4,887	4,887	4,887	4,887	1,964	1,964	1,964	1,964	1,473	1,473	1,473	1473
Weighting			X	X			X	X			X	X

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	Smallest 1/3 ESTAR Buildings (<125,000 SF)				Mid 1/3 ESTAR Buildings				Largest 1/3 (>256,150 SF)			
Variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**	**Model10**	**Model11**	**Model12**
age40	2.616	-4.829	-4.202	-14.853	-51.413^{***}	-48.529^{***}	-52.883^{***}	-35.844^{*}	-90.962^{***}	-141.95^{***}	-148.80^{***}	-202.47^{***}
	(0.619)	(-1.310)	(-1.139)	(-1.620)	(-2.665)	(-2.914)	(-3.168)	(-1.703)	(-3.034)	(-5.529)	(-5.628)	(-6.829)
age30	5.171	-4.288	-3.273	-20.446^{**}	-43.324^{**}	-31.024^{**}	-36.549^{**}	-50.680^{***}	-112.68^{***}	-127.49^{***}	-131.92^{***}	-153.64^{***}
	(1.352)	(-1.284)	(-0.978)	(-2.441)	(-2.439)	(-2.028)	(-2.356)	(-2.605)	(-4.009)	(-5.312)	(-5.345)	(-5.651)
age20	14.315^{***}	1.381	1.865	-20.199^{***}	-36.932^{**}	-30.095^{**}	-34.769^{**}	-52.328^{***}	-107.18^{***}	-116.22^{***}	-121.98^{***}	-137.56^{***}
	(3.943)	(0.435)	(0.586)	(-2.621)	(-2.293)	(-2.183)	(-2.480)	(-3.130)	(-4.020)	(-5.110)	(-5.188)	(-5.344)
age15	35.240^{***}	24.408^{***}	22.919^{***}	19.338^{*}	-12.714	-12.902	-21.610	-33.726	-98.502^{***}	-113.33^{***}	-121.06^{***}	-122.27^{***}
	(6.367)	(5.107)	(4.800)	(1.822)	(-0.537)	(-0.637)	(-1.067)	(-1.404)	(-2.885)	(-3.892)	(-4.103)	(-3.629)
age10	46.378^{***}	36.665^{***}	35.458^{***}	21.049^{**}	24.101	30.088^{*}	18.737	6.720	-61.176^{*}	-73.604^{**}	-80.146^{***}	-84.785^{**}
	(10.224)	(9.256)	(8.951)	(2.444)	(1.326)	(1.944)	(1.195)	(0.367)	(-1.722)	(-2.419)	(-2.586)	(-2.215)
age5	46.093^{***}	34.341^{***}	33.247^{***}	26.429^{***}	40.290^{**}	53.398^{***}	42.297^{***}	20.315	-0.327	-24.286	-29.750	-35.412
	(10.459)	(8.932)	(8.662)	(3.124)	(2.216)	(3.449)	(2.707)	(1.133)	(-0.010)	(-0.908)	(-1.088)	(-1.223)
stories	8.881^{***}	2.724^{***}	3.002^{***}	8.545^{***}	-0.342	0.615	0.730	2.848^{***}	-1.279^{**}	0.072	0.175	1.427^{***}
	(17.447)	(5.976)	(6.603)	(15.037)	(-0.521)	(1.052)	(1.255)	(4.888)	(-2.266)	(0.143)	(0.351)	(2.861)
A Class	67.296^{***}	70.511^{***}	70.639^{***}	133.951^{***}	88.541^{***}	56.792^{***}	58.677^{***}	121.879^{***}	121.270^{***}	65.771^{***}	58.485^{**}	42.775
	(16.424)	(19.718)	(19.846)	(22.303)	(6.058)	(4.425)	(4.579)	(6.183)	(4.471)	(2.816)	(2.453)	(0.935)
B Class	26.151^{***}	26.676^{***}	26.559^{***}	57.293^{***}	44.618^{***}	31.925^{***}	33.720^{***}	86.083^{***}	50.423^{*}	26.064	17.915	-6.116
	(13.915)	(16.312)	(16.315)	(13.698)	(3.308)	(2.746)	(2.917)	(4.673)	(1.917)	(1.166)	(0.787)	(-0.134)
lnland	-11.802^{***}	3.475^{***}	3.117^{***}	1.770	-34.196^{***}	-15.371^{***}	-16.324^{***}	-26.661^{***}	-38.807^{***}	-11.463^{***}	-11.829^{***}	-10.933^{*}
	(-11.644)	(3.851)	(3.470)	(0.925)	(-10.823)	(-5.228)	(-5.573)	(-7.463)	(-8.196)	(-2.606)	(-2.663)	(-1.740)
Amenity	4.003^{**}	5.483^{***}	5.799^{***}	0.962	42.032^{***}	34.191^{***}	38.049^{***}	20.596^{*}	55.113^{***}	89.920^{***}	93.764^{***}	130.849^{***}
	(2.372)	(3.649)	(3.879)	(0.281)	(4.652)	(4.364)	(4.840)	(1.813)	(3.507)	(6.664)	(6.871)	(6.256)
Year 2002	7.254^{*}	2.355	2.115	48.707^{***}	22.693	-2.707	-4.967	-21.858	-16.095	-9.985	-9.163	33.417
	(1.687)	(0.636)	(0.574)	(5.518)	(1.236)	(-0.173)	(-0.321)	(-1.035)	(-0.529)	(-0.388)	(-0.357)	(0.886)
Year 2003	6.533	2.208	2.446	-10.469	2.124	1.766	1.687	-16.745	-12.624	-8.960	7.706	32.759
	(1.546)	(0.607)	(0.676)	(-1.173)	(0.121)	(0.118)	(0.114)	(-0.779)	(-0.453)	(-0.379)	(0.325)	(0.975)
Year 2004	12.249^{***}	8.052^{**}	8.473^{**}	-7.276	16.738	15.629	17.844	9.828	-12.738	-22.605	-13.623	15.795
	(3.050)	(2.327)	(2.461)	(-0.877)	(1.025)	(1.117)	(1.291)	(0.507)	(-0.484)	(-1.015)	(-0.612)	(0.487)
Year 2005	27.578^{***}	24.766^{***}	25.670^{***}	31.758^{***}	36.095^{**}	29.310^{**}	30.535^{**}	28.959^{*}	3.987	1.695	9.254	15.725
R Square	0.112	0.348	0.357	0.417	0.293	0.525	0.548	0.608	0.246	0.505	0.526	0.602
Model N	41, 266	41, 266	41, 266	41, 266	4, 542	4, 542	4, 542	4, 542	2, 822	2, 822	2, 822	2, 822
ESTAR-N	825	825	825	825	824	824	824	824	824	824	824	824
LEED-N	114	114	114	114	82	82	82	82	82	82	82	82
Dual-N	68	68	68	68	147	147	147	147	413	413	413	413
Non-Eco-N	40,353	40,353	40,353	40,353	3,577	3,577	3,577	3,577	1,506	1,506	1,506	
Prof Owner	4,887	4,887	4,887	4,887	1,964	1,964	1,964	1,964	1,473	1,473	1,473	1473
Weighting			X	X			X	X			X	X

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Variable	Smallest 1/3 ESTAR Buildings (<125,000 SF)				Mid 1/3 ESTAR Buildings				Largest 1/3 (>256,150 SF)			
	Model1	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**	**Model10**	**Model11**	**Model12**
	(7.146)	(7.447)	(7.750)	(4.084)	(2.494)	(2.379)	(2.501)	(1.662)	(0.160)	(0.080)	(0.435)	(0.497)
Year 2006	50.079***	44.687***	45.518***	66.503***	58.528***	52.445***	53.443***	61.130***	29.289	39.734*	47.702**	99.225***
	(12.973)	(13.414)	(13.702)	(8.970)	(4.250)	(4.468)	(4.598)	(3.697)	(1.176)	(1.873)	(2.244)	(3.161)
Year 2007	58.145***	57.838***	59.491***	69.541***	67.315***	67.920***	71.616***	106.076***	47.955**	61.926***	72.587***	151.601***
	(15.272)	(17.570)	(18.100)	(9.558)	(4.920)	(5.776)	(6.147)	(6.493)	(1.981)	(2.991)	(3.491)	(5.004)
Year 2008	64.706***	66.035***	68.551***	93.634***	79.445***	76.937***	81.889***	111.152***	102.450***	100.941***	112.147***	232.841***
	(17.324)	(20.304)	(21.097)	(12.951)	(5.826)	(6.468)	(6.939)	(6.746)	(4.241)	(4.816)	(5.322)	(7.741)
Year 2009	55.549***	66.384***	68.690***	113.223***	105.346***	103.353***	104.001***	144.611***	50.489*	69.164***	79.435***	186.813***
	(13.863)	(18.967)	(19.663)	(14.510)	(6.638)	(7.523)	(7.646)	(8.031)	(1.781)	(2.815)	(3.235)	(5.539)
Year 2010	18.717***	27.676***	33.110***	53.321***	42.960***	38.969***	55.416***	121.177***	38.615	18.173	36.392	85.285***
	(4.802)	(8.106)	(9.614)	(6.500)	(2.805)	(2.952)	(4.117)	(6.344)	(1.461)	(0.800)	(1.565)	(2.586)
Year 2011	20.487***	24.344***	32.156***	114.108***	61.036***	42.060***	58.157***	92.203***	62.385**	29.969	54.327**	121.956***
	(4.447)	(6.078)	(7.899)	(12.239)	(3.681)	(2.935)	(4.000)	(4.765)	(2.373)	(1.327)	(2.359)	(3.881)
1031			16.155***	−0.949			6.177	−14.825			22.138	−12.141
			(6.645)	(−0.191)			(0.511)	(−1.019)			(1.285)	(−0.598)
Assemblage			32.413***	35.140			−3.291	−30.056			177.974	180.837
			(3.232)	(1.515)			(−0.072)	(−0.518)			(1.288)	(1.080)
Build to Suit			45.582***	12.092			−15.136	9.197			−135.09	−256.36
			(3.770)	(0.568)			(−0.421)	(0.185)			(−1.412)	(−1.445)
Business Value			12.077	169.041***			111.450	38.665			36.670	−47.616
			(0.615)	(4.136)			(1.595)	(0.560)			(0.372)	(−0.343)
Condo Conversion			33.352***	116.203***			3.446	−42.953			20.206	−35.749
			(2.943)	(6.936)			(0.134)	(−1.129)			(0.305)	(−0.400)
Contamination			−41.025*	−97.309			0.000	0.000			−0.256	−20.679
			(−1.675)	(−1.061)			(.)	(.)			(−0.002)	(−0.073)
Deed Restriction			−4.675	−8.415			0.000	0.000			−38.923	−32.648
			(−0.163)	(−0.135)			(.)	(.)			(−0.277)	(−0.018)
Deferred Maintenance			−14.311***	5.360			0.623	42.592			11.904	27.008
			(−2.845)	(0.439)			(0.022)	(0.806)			(0.322)	(0.539)
R Square	0.112	0.348	0.357	0.417	0.293	0.525	0.548	0.608	0.246	0.505	0.526	0.602
Model N	41, 266	41, 266	41, 266	41, 266	4, 542	4, 542	4, 542	4, 542	2, 822	2, 822	2, 822	2, 822
ESTAR-N	825	825	825	825	824	824	824	824	824	824	824	824
LEED-N	114	114	114	114	82	82	82	82	82	82	82	82
Dual-N	68	68	68	68	147	147	147	147	413	413	413	413
Non-Eco-N	40,353	40,353	40,353	40,353	3,577	3,577	3,577	3,577	1,506	1,506	1,506	
Prof Owner	4,887	4,887	4,887	4,887	1,964	1,964	1,964	1,964	1,473	1,473	1,473	1473
Weighting			X	X			X	X			X	X

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	Smallest 1/3 ESTAR Buildings (<125,000 SF)				Mid 1/3 ESTAR Buildings				Largest 1/3 (>256,150 SF)			
Variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**	**Model10**	**Model11**	**Model12**
Distressed Sale			-27.862^{***}	-67.654^{***}			-18.750	-103.26^{*}			-68.916^{**}	-86.219^{**}
			(-3.686)	(-3.481)			(-0.490)	(-1.692)			(-2.565)	(-2.055)
Ground Lease			32.085^{***}	107.876^{***}			-21.278	-22.546			-35.142^{*}	-39.545^{*}
			(3.882)	(8.937)			(-1.544)	(-1.346)			(-1.763)	(-1.837)
High Vacancy			-6.233	30.173^{***}			-63.149^{***}	-98.642^{***}			-49.792^{**}	-69.973^{**}
			(-1.150)	(2.894)			(-5.212)	(-5.283)			(-2.180)	(-2.021)
Historical			13.912	70.909^{***}			16.042	-52.917			21.782	36.102
			(1.028)	(3.175)			(0.352)	(-0.989)			(0.355)	(0.535)
Investor NNN			31.323^{***}	28.993^{***}			20.137	14.124			34.660^{*}	13.315
			(7.090)	(3.441)			(1.393)	(0.795)			(1.727)	(0.521)
Land Contract			-19.796	-64.197			0.000	0.000			0.000	0.000
			(-1.200)	(-0.847)			(.)	(.)			(.)	(.)
Option Sale			10.215	-27.833			41.506	95.287^{***}			-14.833	1.513
			(1.145)	(-1.526)			(1.550)	(3.201)			(-0.344)	(0.026)
Partial Interest			-48.897^{***}	235.055^{***}			-36.445	-20.371			-71.259^{***}	-144.33^{***}
			(-4.518)	(10.985)			(-1.625)	(-0.792)			(-3.544)	(-7.684)
Redevelopment			35.321^{***}	22.694			-17.457	-44.846			-100.13^{**}	-138.94
			(4.221)	(1.419)			(-0.718)	(-1.043)			(-2.279)	(-1.258)
REO			-40.199^{***}	-92.621^{***}			-70.511^{***}	-128.65^{**}			16.249	-12.716
			(-6.092)	(-5.127)			(-2.923)	(-2.563)			(0.379)	(-0.253)
Sale Leaseback			12.457^{***}	7.669			27.953^{**}	48.142^{***}			1.162	-51.203^{**}
			(2.584)	(0.819)			(1.972)	(2.637)			(0.063)	(-2.269)
Shell Condition			3.916	-52.309^{**}			-77.977	-126.66			-34.148	-112.47
			(0.326)	(-2.052)			(-1.548)	(-1.616)			(-0.255)	(-0.228)
Short Sale			-35.725^{*}	-129.46^{**}			0.000	0.000			3.106	-19.940
			(-1.843)	(-2.349)			(.)	(.)			(0.024)	(-0.215)
Single Tenant			8.712^{***}	23.520^{***}			4.393	11.441			22.797	87.565^{***}
			(4.912)	(5.893)			(0.536)	(1.068)			(1.462)	(3.889)
Tenant Purchase			9.286^{**}	21.938^{**}			46.811^{**}	75.623^{***}			23.428	59.957
R Square	0.112	0.348	0.357	0.417	0.293	0.525	0.548	0.608	0.246	0.505	0.526	0.602
Model N	41, 266	41, 266	41, 266	41, 266	4, 542	4, 542	4, 542	4, 542	2, 822	2, 822	2, 822	2, 822
ESTAR-N	825	825	825	825	824	824	824	824	824	824	824	824
LEED-N	114	114	114	114	82	82	82	82	82	82	82	82
Dual-N	68	68	68	68	147	147	147	147	413	413	413	413
Non-Eco-N	40,353	40,353	40,353	40,353	3,577	3,577	3,577	3,577	1,506	1,506	1,506	
Prof Owner	4,887	4,887	4,887	4,887	1,964	1,964	1,964	1,964	1,473	1,473	1,473	1473
Weighting			X	X			X	X			X	X

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	Smallest 1/3 ESTAR Buildings (<125,000 SF)				Mid 1/3 ESTAR Buildings				Largest 1/3 (>256,150 SF)			
Variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**	**Model10**	**Model11**	**Model12**
			(2.101)	(2.278)			(2.409)	(3.167)			(0.737)	(1.433)
R Square	0.112	0.348	0.357	0.417	0.293	0.525	0.548	0.608	0.246	0.505	0.526	0.602
Model N	41, 266	41, 266	41, 266	41, 266	4, 542	4, 542	4, 542	4, 542	2, 822	2, 822	2, 822	2, 822
ESTAR-N	825	825	825	825	824	824	824	824	824	824	824	824
LEED-N	114	114	114	114	82	82	82	82	82	82	82	82
Dual-N	68	68	68	68	147	147	147	147	413	413	413	413
Non-Eco-N	40,353	40,353	40,353	40,353	3,577	3,577	3,577	3,577	1,506	1,506	1,506	
Prof Owner	4,887	4,887	4,887	4,887	1,964	1,964	1,964	1,964	1,473	1,473	1,473	1473
Prof Owner-N	5260	5260	5260	5260	1880	1880	1880	1880	1184	1184	1184	1184
Weighting			X	X			X	X			X	X

Table D: This table presents results from OLS regressions on sales PSF of the building population split into thirds by size. No controls were in Model 1, 5, and 9. Models 2, 6, and 10 include market dummy controls. Models 3, 7, and 11 also include market dummy controls and sale condition control dummies. Models 4, 8, and 12 include market dummy controls, sale condition controls, and are weighted by lnsize. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	>17,435 SF				**Medium**				**>44,000 SF**			
Variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**	**Model10**	**Model11**	**Model12**
ESTAR	-33.600	-25.681	-25.887	-59.177	77.326^{***}	40.327^{*}	40.770^{*}	93.014^{***}	30.893^{***}	26.899^{***}	26.964^{***}	15.550^{***}
	(-0.864)	(-0.790)	(-0.805)	(-0.863)	(3.112)	(1.909)	(1.942)	(2.718)	(6.328)	(6.204)	(6.264)	(3.065)
LEED	19.430	37.227	34.893	123.834^{**}	54.839^{**}	45.461^{**}	48.465^{**}	129.350^{***}	90.374^{***}	70.923^{***}	72.410^{***}	54.687^{***}
	(0.590)	(1.353)	(1.280)	(2.520)	(2.293)	(2.241)	(2.403)	(3.341)	(7.417)	(6.653)	(6.852)	(5.035)
Dual	-9.286	-27.402	-47.991	-139.78^{*}	-49.176	-14.033	-16.452	32.254	43.869^{***}	51.214^{***}	49.693^{***}	25.175^{***}
	(-0.169)	(-0.598)	(-1.057)	(-1.650)	(-0.811)	(-0.273)	(-0.322)	(0.231)	(5.338)	(7.049)	(6.894)	(3.704)
Prof Buyer		206.732^{***}	207.150^{***}	358.974^{***}		103.720^{***}	105.510^{***}	262.662^{***}		22.276^{***}	22.625^{***}	-10.859^{**}
		(8.479)	(8.576)	(12.418)		(7.655)	(7.817)	(12.580)		(5.037)	(5.153)	(-2.079)
Prof Seller		21.271	23.054	13.781		25.107	22.896	10.371		56.163^{***}	52.544^{***}	32.656^{***}
		(0.774)	(0.849)	(0.298)		(1.621)	(1.487)	(0.334)		(7.415)	(6.989)	(3.897)
Prof Both		0.000	0.000	0.000		-79.580	-91.333	-353.13		60.719^{***}	61.847^{***}	68.858^{***}
		(.)	(.)	(.)		(-0.774)	(-0.891)	(-1.023)		(4.403)	(4.526)	(5.322)
Intercept	443.192^{***}	300.038^{***}	313.185^{***}	430.658^{***}	407.848^{***}	339.426^{***}	332.560^{***}	1097.56^{***}	258.120^{***}	182.970^{***}	179.198^{***}	575.601^{***}
	(5.794)	(4.533)	(4.781)	(3.338)	(7.734)	(7.121)	(6.995)	(10.040)	(8.322)	(5.661)	(5.565)	(10.819)
lnsize	-39.744^{***}	-35.135^{***}	-36.436^{***}	-53.209^{***}	-28.961^{***}	-32.379^{***}	-31.984^{***}	-121.74^{***}	11.578^{***}	-1.134	-0.818	-12.491^{***}
	(-4.805)	(-5.076)	(-5.321)	(-3.963)	(-5.241)	(-6.898)	(-6.831)	(-11.373)	(3.790)	(-0.419)	(-0.304)	(-3.441)
age100	25.108^{***}	1.838	0.938	-8.695	23.800^{***}	10.340	9.700	110.422^{***}	0.772	-22.892^{***}	-23.771^{***}	-72.507^{***}
	(3.116)	(0.263)	(0.135)	(-0.631)	(2.818)	(1.401)	(1.314)	(6.181)	(0.080)	(-2.653)	(-2.754)	(-5.386)
age75	27.362^{***}	-1.095	-3.288	-23.708^{*}	14.534^{*}	-7.262	-7.490	41.377^{**}	-7.600	-42.422^{***}	-43.298^{***}	-155.25^{***}
	(3.714)	(-0.173)	(-0.524)	(-1.849)	(1.884)	(-1.087)	(-1.120)	(2.465)	(-0.889)	(-5.516)	(-5.619)	(-13.298)
age50	21.694^{***}	6.446	6.388	85.560^{***}	2.284	-2.270	-1.453	8.964	-29.698^{***}	-39.339^{***}	-38.614^{***}	-114.73^{***}
	(3.315)	(1.149)	(1.148)	(7.336)	(0.308)	(-0.356)	(-0.228)	(0.551)	(-3.223)	(-4.849)	(-4.773)	(-8.945)
age40	4.704	-6.050	-6.201	-7.544	3.159	-4.732	-3.059	-1.254	-19.429^{**}	-30.994^{***}	-31.653^{***}	-140.09^{***}
	(0.738)	(-1.108)	(-1.142)	(-0.656)	(0.452)	(-0.788)	(-0.508)	(-0.081)	(-2.301)	(-4.175)	(-4.267)	(-12.267)
Model N	8,460	8,460	8,460	8,460	8,476	8,476	8,476	8,476	8,579	8,579	8,579	8,579
ESTAR-N	10	10	10	10	24	24	24	24	899	899	899	899
Dual-N	5	5	5	5	4	4	4	4	286	286	286	286
LEED N	14	14	14	14	26	26	26	26	118	118	118	118
Prof Seller N	15	15	15	15	45	45	45	45	226	226	226	226
Prof Buyer N	18	18	18	18	60	60	60	60	771	771	771	771
Prof Both N	0	0	0	0	1	1	1	1	66	66	66	66
Sale Condition Controls			X	X			X	X			X	X
Weighting				X				X				X

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	>17,435 SF				Medium				>44,000 SF			
Variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**	**Model10**	**Model11**	**Model12**
age30	14.519^{**}	-1.670	-1.377	-1.830	3.351	-5.625	-4.560	-9.353	-26.059^{***}	-26.817^{***}	-26.569^{***}	-123.88^{***}
	(2.497)	(-0.333)	(-0.276)	(-0.176)	(0.530)	(-1.036)	(-0.834)	(-0.670)	(-3.408)	(-3.994)	(-3.948)	(-11.740)
age20	17.827^{***}	3.493	3.669	-3.219	14.827^{**}	3.179	3.363	8.596	-16.062^{**}	-25.745^{***}	-26.296^{***}	-112.38^{***}
	(3.181)	(0.723)	(0.764)	(-0.323)	(2.463)	(0.613)	(0.644)	(0.650)	(-2.262)	(-4.134)	(-4.201)	(-11.641)
age15	35.244^{***}	20.949^{***}	18.780^{**}	13.922	36.896^{***}	26.055^{***}	25.029^{***}	14.041	8.340	4.946	2.400	-77.814^{***}
	(4.017)	(2.830)	(2.557)	(0.965)	(4.058)	(3.366)	(3.231)	(0.775)	(0.826)	(0.562)	(0.273)	(-6.013)
age10	49.112^{***}	37.184^{***}	37.459^{***}	49.749^{***}	44.467^{***}	37.825^{***}	36.355^{***}	38.486^{**}	28.084^{***}	20.499^{***}	17.276^{**}	-57.348^{***}
	(6.586)	(5.833)	(5.919)	(4.023)	(5.878)	(5.834)	(5.591)	(2.522)	(3.420)	(2.840)	(2.396)	(-4.961)
age5	50.276^{***}	34.330^{***}	33.340^{***}	32.557^{***}	41.814^{***}	36.429^{***}	36.064^{***}	36.986^{**}	42.672^{***}	32.379^{***}	29.126^{***}	-18.579^{*}
	(7.231)	(5.752)	(5.618)	(2.846)	(5.719)	(5.800)	(5.743)	(2.506)	(5.204)	(4.514)	(4.071)	(-1.745)
stories	29.093^{***}	7.722^{***}	8.215^{***}	13.432^{***}	14.381^{***}	5.204^{***}	5.495^{***}	7.621^{***}	0.276	0.410^{*}	0.551^{**}	0.681^{***}
	(16.470)	(4.802)	(5.161)	(4.591)	(12.320)	(5.035)	(5.336)	(3.948)	(1.018)	(1.678)	(2.268)	(3.277)
A Class	75.449	75.117^{*}	70.015^{*}	117.904^{*}	46.525^{***}	57.992^{***}	58.930^{***}	110.203^{***}	87.529^{***}	71.459^{***}	71.274^{***}	100.597^{***}
	(1.502)	(1.788)	(1.686)	(1.698)	(4.346)	(6.341)	(6.482)	(6.195)	(16.172)	(14.781)	(14.835)	(9.535)
B Class	22.440^{***}	23.262^{***}	23.011^{***}	34.168^{***}	23.679^{***}	22.508^{***}	22.178^{***}	24.156^{***}	44.362^{***}	35.722^{***}	35.621^{***}	56.352^{***}
	(7.790)	(9.510)	(9.507)	(7.250)	(7.908)	(8.721)	(8.629)	(3.860)	(9.954)	(9.131)	(9.181)	(5.720)
lnland	-5.325^{***}	7.913^{***}	7.393^{***}	9.642^{***}	-7.518^{***}	6.388^{***}	6.050^{***}	15.688^{***}	-28.011^{***}	-9.741^{***}	-9.935^{***}	-28.211^{***}
	(-3.133)	(5.381)	(5.076)	(3.237)	(-4.309)	(4.188)	(3.984)	(4.366)	(-18.767)	(-7.069)	(-7.244)	(-13.732)
Amenity	4.154	1.212	1.117	-11.690^{**}	4.877^{*}	5.451^{**}	5.416^{**}	-7.012	10.707^{***}	18.167^{***}	19.825^{***}	47.610^{***}
	(1.535)	(0.513)	(0.478)	(-2.541)	(1.789)	(2.269)	(2.265)	(-1.247)	(3.217)	(6.144)	(6.739)	(7.787)
Year 2002	10.919	7.461	7.511	26.084^{**}	3.791	-0.096	0.474	-7.625	8.322	0.760	-1.083	32.129^{**}
	(1.538)	(1.257)	(1.279)	(1.966)	(0.534)	(-0.016)	(0.079)	(-0.477)	(1.107)	(0.116)	(-0.167)	(2.536)
Year 2003	10.642	7.516	8.136	6.188	12.378^{*}	6.235	6.634	-1.548	-9.613	-7.992	-7.791	1.331
	(1.548)	(1.306)	(1.426)	(0.479)	(1.789)	(1.059)	(1.132)	(-0.102)	(-1.282)	(-1.221)	(-1.200)	(0.111)
Year 2004	22.019^{***}	18.128^{***}	18.547^{***}	14.264	11.213^{*}	10.361^{*}	10.913^{**}	4.753	0.429	-4.877	-4.151	-8.657
	(3.291)	(3.235)	(3.341)	(1.160)	(1.725)	(1.874)	(1.983)	(0.330)	(0.062)	(-0.800)	(-0.687)	(-0.764)
Year 2005	41.685^{***}	39.641^{***}	40.054^{***}	50.234^{***}	21.018^{***}	20.333^{***}	21.956^{***}	14.624	15.476^{**}	12.668^{**}	13.334^{**}	17.418
	(6.497)	(7.379)	(7.516)	(4.341)	(3.341)	(3.801)	(4.118)	(1.060)	(2.353)	(2.209)	(2.344)	(1.623)
Year 2006	61.119^{***}	55.559^{***}	56.112^{***}	78.735^{***}	50.623^{***}	46.014^{***}	48.014^{***}	71.788^{***}	35.738^{***}	32.755^{***}	32.884^{***}	72.376^{***}
Model N	8,460	8,460	8,460	8,460	8,476	8,476	8,476	8,476	8,579	8,579	8,579	8,579
ESTAR-N	10	10	10	10	24	24	24	24	899	899	899	899
Dual-N	5	5	5	5	4	4	4	4	286	286	286	286
LEED N	14	14	14	14	26	26	26	26	118	118	118	118
Prof Seller N	15	15	15	15	45	45	45	45	226	226	226	226
Prof Buyer N	18	18	18	18	60	60	60	60	771	771	771	771
Prof Both N	0	0	0	0	1	1	1	1	66	66	66	66
Sale Condition Controls			X	X			X	X			X	X
Weighting				X				X				X

Continued on next page

	>17,435 SF				Medium				>44,000 SF			
Variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**	**Model10**	**Model11**	**Model12**
	(9.258)	(10.035)	(10.219)	(6.784)	(8.033)	(8.566)	(8.953)	(5.381)	(5.644)	(5.923)	(5.987)	(7.002)
Year 2007	70.611***	71.693***	72.294***	88.895***	61.959***	60.977***	62.780***	84.366***	43.955***	45.283***	47.492***	111.343***
	(10.780)	(13.037)	(13.215)	(7.750)	(9.983)	(11.522)	(11.876)	(6.477)	(7.070)	(8.300)	(8.759)	(11.064)
Year 2008	67.184***	74.915***	76.660***	100.093***	68.317***	67.333***	70.309***	109.448***	64.511***	60.720***	64.195***	155.655***
	(10.560)	(13.932)	(14.305)	(8.832)	(11.159)	(12.841)	(13.420)	(8.498)	(10.469)	(11.088)	(11.795)	(15.471)
Year 2009	69.951***	83.584***	85.004***	155.653***	49.727***	61.856***	64.360***	94.123***	53.235***	59.849***	62.716***	131.344***
	(10.524)	(14.779)	(15.105)	(13.208)	(7.626)	(11.028)	(11.491)	(6.852)	(7.601)	(9.620)	(10.150)	(11.792)
Year 2010	26.614***	40.480***	44.178***	68.068***	15.103**	28.099***	33.492***	32.816**	19.394***	16.352***	28.344***	76.131***
	(4.185)	(7.466)	(8.122)	(5.737)	(2.343)	(5.039)	(5.957)	(2.256)	(2.843)	(2.710)	(4.627)	(6.709)
Year 2011	24.959***	30.558***	35.568***	86.320***	15.252**	23.179***	31.565***	137.147***	34.339***	20.482***	36.639***	89.198***
	(3.222)	(4.668)	(5.404)	(6.115)	(2.054)	(3.640)	(4.858)	(8.192)	(4.521)	(3.049)	(5.366)	(8.023)
1031			17.531***	−0.299			20.314***	30.050***			11.505***	−8.607
			(4.257)	(−0.041)			(5.380)	(3.752)			(2.636)	(−1.171)
Assemblage			45.842***	55.543**			16.953	−17.911			10.615	57.410
			(2.949)	(2.265)			(1.071)	(−0.509)			(0.528)	(1.361)
Build to Suit			35.439	30.519			72.718***	63.326*			−4.542	−64.679*
			(1.582)	(0.793)			(3.798)	(1.662)			(−0.246)	(−1.815)
Business Value			0.508	−51.569			32.441	9.095			61.701*	63.019
			(0.019)	(−0.879)			(0.898)	(0.104)			(1.808)	(1.410)
Condo Conversion			113.769***	329.173***			−1.483	−50.473			24.397*	46.316*
			(3.529)	(8.171)			(−0.077)	(−1.342)			(1.828)	(1.908)
Contamination			−3.646	1.728			−111.47***	−299.91**			−23.913	51.037
			(−0.107)	(0.022)			(−2.665)	(−2.314)			(−0.444)	(0.358)
Deed Restriction			22.205	41.994			−5.791	−34.403			−12.294	−24.810
			(0.310)	(0.272)			(−0.139)	(−0.332)			(−0.279)	(−0.175)
Deferred Maintenance			−18.820**	−16.777			−13.628*	−46.282**			−5.097	36.400*
			(−2.178)	(−0.859)			(−1.760)	(−2.180)			(−0.559)	(1.952)
Distressed Sale			−22.638*	54.596*			−14.014	−11.250			−45.444***	−76.907***
			(−1.763)	(1.884)			(−1.106)	(−0.334)			(−4.093)	(−4.087)
Model N	8,460	8,460	8,460	8,460	8,476	8,476	8,476	8,476	8,579	8,579	8,579	8,579
ESTAR-N	10	10	10	10	24	24	24	24	899	899	899	899
Dual-N	5	5	5	5	4	4	4	4	286	286	286	286
LEED N	14	14	14	14	26	26	26	26	118	118	118	118
Prof Seller N	15	15	15	15	45	45	45	45	226	226	226	226
Prof Buyer N	18	18	18	18	60	60	60	60	771	771	771	771
Prof Both N	0	0	0	0	1	1	1	1	66	66	66	66
Sale Condition Controls			X	X			X	X			X	X
Weighting				X				X				X

Continued on next page

Variable	Model1	Model2	Model3	Model4	Model5	Model6	Model7	Model8	Model9	Model10	Model11	Model12
		>17,435 SF				Medium				>44,000 SF		
Ground Lease			198.245***	1124.37***			20.439	146.538***			−7.226	−24.988***
			(6.779)	(31.395)			(1.350)	(5.091)			(−0.942)	(−2.722)
High Vacancy			28.940*	24.065			15.791*	290.697***			−42.685***	−75.908***
			(1.806)	(0.884)			(1.709)	(14.170)			(−6.843)	(−6.238)
Historical			−18.316	−169.14***			−6.908	−124.44***			34.064*	69.850***
			(−0.621)	(−3.091)			(−0.321)	(−2.636)			(1.838)	(2.674)
Investor NNN			42.378***	62.423***			26.540***	13.666			25.409***	6.671
			(5.616)	(4.602)			(3.699)	(0.878)			(3.802)	(0.677)
Land Contract			−14.621	−16.923			−13.066	−31.806			−21.393	−58.042
			(−0.703)	(−0.286)			(−0.472)	(−0.321)			(−0.280)	(−0.091)
Option Sale			15.502	14.846			3.270	−41.682			8.732	24.478
			(1.021)	(0.537)			(0.221)	(−1.234)			(0.656)	(1.193)
Partial Interest			47.458**	1882.87***			−73.625***	−75.939			−65.253***	−139.69***
			(2.422)	(65.175)			(−3.989)	(−1.630)			(−6.024)	(−15.355)
Redevelopment			120.706***	398.490***			19.084	−1.517			−27.890**	−98.592***
			(7.463)	(18.248)			(1.463)	(−0.056)			(−2.315)	(−3.587)
REO			−43.294***	−65.870**			−41.331***	−159.39***			−45.456***	−70.735***
			(−4.033)	(−2.372)			(−3.911)	(−4.886)			(−4.027)	(−3.388)
Sale Leaseback			1.421	−23.053			25.860***	38.725**			15.977**	−9.301
			(0.189)	(−1.599)			(3.053)	(2.157)			(2.287)	(−0.981)
Shell Condition			29.552	18.483			−5.821	−18.665			−46.198**	−162.88***
			(1.524)	(0.593)			(−0.302)	(−0.433)			(−2.111)	(−3.078)
Short Sale			−30.560	−73.853			−48.990	−153.56			−22.071	−49.214
			(−0.990)	(−1.069)			(−1.644)	(−1.546)			(−0.538)	(−1.062)
Single Tenant			8.239***	11.268**			8.620***	46.021***			7.019**	29.041***
			(3.054)	(2.168)			(2.985)	(6.924)			(2.031)	(4.394)
Tenant Purchase			−3.775	−7.907			18.168***	−0.167			24.129***	56.593***
			(−0.551)	(−0.548)			(2.580)	(−0.010)			(2.870)	(4.027)
R Square	0.114	0.390	0.407	0.698	0.106	0.367	0.378	0.487	0.206	0.406	0.420	0.500
Model N	8,460	8,460	8,460	8,460	8,476	8,476	8,476	8,476	8,579	8,579	8,579	8,579
ESTAR-N	10	10	10	10	24	24	24	24	899	899	899	899
Dual-N	5	5	5	5	4	4	4	4	286	286	286	286
LEED N	14	14	14	14	26	26	26	26	118	118	118	118
Prof Seller N	15	15	15	15	45	45	45	45	226	226	226	226
Prof Buyer N	18	18	18	18	60	60	60	60	771	771	771	771
Prof Both N	0	0	0	0	1	1	1	1	66	66	66	66
Sale Condition Controls			X	X			X	X			X	X
Weighting				X				X				X

Table E: This table presents results from OLSDV regressions on sales PSF of the building population split into thirds by the ESTAR distribution. In each size category results are presented first with the core controls, then with professional ownership controls added, then with sale condition controls also added, and finally weighted by price with all controls. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

	size<=151,775				Medium				size>=280,563			
Variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model7**	**Model8**	**Model9**	**Model10**	**Model11**	**Mod**
ESTAR	−33.600	−25.681	−25.887	−59.177	77.326***	40.327*	40.770*	93.014***	26.742***	23.922***	24.089***	−7.5
	(−0.864)	(−0.790)	(−0.805)	(−0.863)	(3.112)	(1.909)	(1.942)	(2.718)	(5.382)	(5.444)	(5.520)	(−1.3
LEED	19.430	37.227	34.893	123.834**	54.839**	45.461**	48.465**	129.350***	87.599***	68.252***	69.831***	33.76
	(0.590)	(1.353)	(1.280)	(2.520)	(2.293)	(2.241)	(2.403)	(3.341)	(7.051)	(6.306)	(6.507)	(2.80
Dual	−9.286	−27.402	−47.991	−139.78*	−49.176	−14.033	−16.452	32.254	39.549***	48.539***	47.393***	8.099
	(−0.169)	(−0.598)	(−1.057)	(−1.650)	(−0.811)	(−0.273)	(−0.322)	(0.231)	(4.745)	(6.615)	(6.507)	(1.14
Prof Buyer		206.732***	207.150***	358.974***		103.720***	105.510***	262.662***		22.704***	23.192***	1.408
		(8.479)	(8.576)	(12.418)		(7.655)	(7.817)	(12.580)		(5.069)	(5.215)	(0.25
Prof Seller		21.271	23.054	13.781		25.107	22.896	10.371		57.267***	53.935***	55.04
		(0.774)	(0.849)	(0.298)		(1.621)	(1.487)	(0.334)		(7.464)	(7.081)	(6.18
Prof Both		0.000	0.000	0.000		−79.580	−91.333	−353.13		71.734***	72.722***	179.7
		(.)	(.)	(.)		(−0.774)	(−0.891)	(−1.023)		(5.163)	(5.280)	(14.0
Intercept	443.192***	300.038***	313.185***	430.658***	407.848***	339.426***	332.560***	1097.56***	233.033***	164.541***	161.488***	330.9
	(5.794)	(4.533)	(4.781)	(3.338)	(7.734)	(7.121)	(6.995)	(10.040)	(7.386)	(5.023)	(4.947)	(5.73
lnsize	−39.744***	−35.135***	−36.436***	−53.209***	−28.961***	−32.379***	−31.984***	−121.74***	12.773***	−0.585	−0.365	0.752
	(−4.805)	(−5.076)	(−5.321)	(−3.963)	(−5.241)	(−6.898)	(−6.831)	(−11.373)	(4.107)	(−0.214)	(−0.134)	(0.19
age100	25.108***	1.838	0.938	−8.695	23.800***	10.340	9.700	110.422***	1.008	−24.639***	−25.620***	−106
	(3.116)	(0.263)	(0.135)	(−0.631)	(2.818)	(1.401)	(1.314)	(6.181)	(0.103)	(−2.813)	(−2.923)	(−7.1
age75	27.362***	−1.095	−3.288	−23.708*	14.534*	−7.262	−7.490	41.377**	−8.284	−45.179***	−46.177***	−181
	(3.714)	(−0.173)	(−0.524)	(−1.849)	(1.884)	(−1.087)	(−1.120)	(2.465)	(−0.951)	(−5.791)	(−5.906)	(−14
age50	21.694***	6.446	6.388	85.560***	2.284	−2.270	−1.453	8.964	−28.023***	−38.962***	−38.294***	−102
	(3.315)	(1.149)	(1.148)	(7.336)	(0.308)	(−0.356)	(−0.228)	(0.551)	(−2.985)	(−4.733)	(−4.664)	(−7.3
age40	4.704	−6.050	−6.201	−7.544	3.159	−4.732	−3.059	−1.254	−15.420*	−28.526***	−29.100***	−89.4
	(0.738)	(−1.108)	(−1.142)	(−0.656)	(0.452)	(−0.788)	(−0.508)	(−0.081)	(−1.793)	(−3.789)	(−3.867)	(−7.2
age30	14.519**	−1.670	−1.377	−1.830	3.351	−5.625	−4.560	−9.353	−26.315***	−27.198***	−27.005***	−124
	(2.497)	(−0.333)	(−0.276)	(−0.176)	(0.530)	(−1.036)	(−0.834)	(−0.670)	(−3.375)	(−3.990)	(−3.951)	(−10
age20	17.827***	3.493	3.669	−3.219	14.827**	3.179	3.363	8.596	−16.402**	−26.331***	−26.884***	−115
	(3.181)	(0.723)	(0.764)	(−0.323)	(2.463)	(0.613)	(0.644)	(0.650)	(−2.265)	(−4.165)	(−4.229)	(−10
age15	35.244***	20.949***	18.780**	13.922	36.896***	26.055***	25.029***	14.041	10.411	6.263	3.718	−65.3
	(4.017)	(2.830)	(2.557)	(0.965)	(4.058)	(3.366)	(3.231)	(0.775)	(1.012)	(0.701)	(0.417)	(−4.6
age10	49.112***	37.184***	37.459***	49.749***	44.467***	37.825***	36.355***	38.486**	28.912***	20.588***	17.425**	−48.3
R Square	0.112	0.348	0.357	0.417	0.293	0.525	0.548	0.608	0.248	0.511	0.530	0.691
Model N	22,819	22,819	22,819	22,819	1,521	1,521	1,521	1,521	1,175	1,175	1,175	1,175
ESTAR-N	311	311	311	311	310	310	310	310	312	312	312	312
LEED N	93	93	93	93	35	35	35	35	30	30	30	30
Dual-N	32	32	32	32	71	71	71	71	192	192	192	192
Non-Eco-N	23,093	23,093	23,093	23,093	1,122	1,122	1,122	1,122	660	660	660	660
Prof Seller N	180	180	180	180	55	55	55	55	51	51	51	51
Prof Buyer N	434	434	434	434	211	211	211	211	204	204	204	204
Prof Both N	23	23	23	23	21	21	21	21	23	23	23	23
Sale Condition Controls			X	X			X	X			X	X
Weighting				X				X				X

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Variable	Model1	Model2	Model3	Model4	Model5	Model6	Model7	Model8	Model9	Model10	Model11	Mod
	Smallest 1/3 ESTAR Buildings (<125,000 SF)				**Mid 1/3 ESTAR Buildings**				**Largest 1/3 (>256,150 SF)**			
	(6.586)	(5.833)	(5.919)	(4.023)	(5.878)	(5.834)	(5.591)	(2.522)	(3.453)	(2.809)	(2.379)	(−3.7
age5	50.276***	34.330***	33.340***	32.557***	41.814***	36.429***	36.064***	36.986**	44.327***	33.186***	30.035***	4.638
	(7.231)	(5.752)	(5.618)	(2.846)	(5.719)	(5.800)	(5.743)	(2.506)	(5.302)	(4.557)	(4.134)	(0.39
stories	29.093***	7.722***	8.215***	13.432***	14.381***	5.204***	5.495***	7.621***	0.730***	0.694***	0.844***	1.097
	(16.470)	(4.802)	(5.161)	(4.591)	(12.320)	(5.035)	(5.336)	(3.948)	(2.654)	(2.810)	(3.437)	(4.84
A Class	75.449	75.117*	70.015*	117.904*	46.525***	57.992***	58.930***	110.203***	87.407***	71.213***	70.997***	101.7
	(1.502)	(1.788)	(1.686)	(1.698)	(4.346)	(6.341)	(6.482)	(6.195)	(15.841)	(14.510)	(14.553)	(8.67
B Class	22.440***	23.262***	23.011***	34.168***	23.679***	22.508***	22.178***	24.156***	43.947***	35.339***	35.232***	53.24
	(7.790)	(9.510)	(9.507)	(7.250)	(7.908)	(8.721)	(8.629)	(3.860)	(9.672)	(8.898)	(8.941)	(4.84
lnland	−5.325***	7.913***	7.393***	9.642***	−7.518***	6.388***	6.050***	15.688***	−27.238***	−8.775***	−8.947***	−21.
	(−3.133)	(5.381)	(5.076)	(3.237)	(−4.309)	(4.188)	(3.984)	(4.366)	(−17.919)	(−6.284)	(−6.436)	(−9.
Amenity	4.154	1.212	1.117	−11.690**	4.877*	5.451**	5.416**	−7.012	10.494***	18.369***	20.043***	36.57
	(1.535)	(0.513)	(0.478)	(−2.541)	(1.789)	(2.269)	(2.265)	(−1.247)	(3.093)	(6.121)	(6.711)	(5.47
Year 2002	10.919	7.461	7.511	26.084**	3.791	−0.096	0.474	−7.625	8.020	0.335	−1.473	28.07
	(1.538)	(1.257)	(1.279)	(1.966)	(0.534)	(−0.016)	(0.079)	(−0.477)	(1.047)	(0.050)	(−0.223)	(1.98
Year 2003	10.642	7.516	8.136	6.188	12.378*	6.235	6.634	−1.548	−9.603	−7.977	−7.804	5.413
	(1.548)	(1.306)	(1.426)	(0.479)	(1.789)	(1.059)	(1.132)	(−0.102)	(−1.257)	(−1.201)	(−1.184)	(0.41
Year 2004	22.019***	18.128***	18.547***	14.264	11.213*	10.361*	10.913**	4.753	−0.278	−5.542	−4.763	−13.
	(3.291)	(3.235)	(3.341)	(1.160)	(1.725)	(1.874)	(1.983)	(0.330)	(−0.039)	(−0.895)	(−0.776)	(−1.
Year 2005	41.685***	39.641***	40.054***	50.234***	21.018***	20.333***	21.956***	14.624	14.720**	12.010**	12.748**	7.752
	(6.497)	(7.379)	(7.516)	(4.341)	(3.341)	(3.801)	(4.118)	(1.060)	(2.195)	(2.062)	(2.206)	(0.64
Year 2006	61.119***	55.559***	56.112***	78.735***	50.623***	46.014***	48.014***	71.788***	35.428***	32.372***	32.566***	68.83
	(9.258)	(10.035)	(10.219)	(6.784)	(8.033)	(8.566)	(8.953)	(5.381)	(5.488)	(5.766)	(5.839)	(6.01
Year 2007	70.611***	71.693***	72.294***	88.895***	61.959***	60.977***	62.780***	84.366***	44.238***	45.437***	47.739***	123.7
	(10.780)	(13.037)	(13.215)	(7.750)	(9.983)	(11.522)	(11.876)	(6.477)	(6.980)	(8.204)	(8.671)	(11.0
Year 2008	67.184***	74.915***	76.660***	100.093***	68.317***	67.333***	70.309***	109.448***	66.826***	62.031***	65.645***	176.5
	(10.560)	(13.932)	(14.305)	(8.832)	(11.159)	(12.841)	(13.420)	(8.498)	(10.643)	(11.164)	(11.884)	(15.9
Year 2009	69.951***	83.584***	85.004***	155.653***	49.727***	61.856***	64.360***	94.123***	55.216***	61.228***	64.228***	176.0
	(10.524)	(14.779)	(15.105)	(13.208)	(7.626)	(11.028)	(11.491)	(6.852)	(7.737)	(9.700)	(10.243)	(14.4
Year 2010	26.614***	40.480***	44.178***	68.068***	15.103**	28.099***	33.492***	32.816**	19.568***	15.982***	27.748***	57.53
	(4.185)	(7.466)	(8.122)	(5.737)	(2.343)	(5.039)	(5.957)	(2.256)	(2.814)	(2.610)	(4.461)	(4.59
Year 2011	24.959***	30.558***	35.568***	86.320***	15.252**	23.179***	31.565***	137.147***	32.955***	18.835***	34.836***	56.83
	(3.222)	(4.668)	(5.404)	(6.115)	(2.054)	(3.640)	(4.858)	(8.192)	(4.255)	(2.762)	(5.024)	(4.60
1031			17.531***	−0.299			20.314***	30.050***			11.625***	−15.
			(4.257)	(−0.041)			(5.380)	(3.752)			(2.624)	(−1.
Assemblage			45.842***	55.543**			16.953	−17.911			10.556	35.00
R Square	0.112	0.348	0.357	0.417	0.293	0.525	0.548	0.608	0.248	0.511	0.530	0.691
Model N	22, 819	22, 819	22, 819	22, 819	1, 521	1, 521	1, 521	1, 521	1, 175	1, 175	1, 175	1, 175
ESTAR-N	311	311	311	311	310	310	310	310	312	312	312	312
LEED N	93	93	93	93	35	35	35	35	30	30	30	30
Dual-N	32	32	32	32	71	71	71	71	192	192	192	192
Non-Eco-N	23,093	23,093	23,093	23,093	1,122	1,122	1,122	1,122	660	660	660	660
Prof Seller N	180	180	180	180	55	55	55	55	51	51	51	51
Prof Buyer N	434	434	434	434	211	211	211	211	204	204	204	204
Prof Both N	23	23	23	23	21	21	21	21	23	23	23	23
Sale Condition Controls			X	X			X	X			X	X
Weighting				X				X				X

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Variable	Smallest 1/3 ESTAR Buildings (<125,000 SF) Model1	Model2	Model3	Model4	Mid 1/3 ESTAR Buildings Model5	Model6	Model7	Model8	Largest 1/3 (>256,150 SF) Model9	Model10	Model11	Mo
			(2.949)	(2.265)			(1.071)	(−0.509)			(0.517)	(0.74
Build to Suit			35.439	30.519			72.718***	63.326*			−5.049	−68.
			(1.582)	(0.793)			(3.798)	(1.662)			(−0.269)	(−1.
Business Value			0.508	−51.569			32.441	9.095			59.371*	64.68
			(0.019)	(−0.879)			(0.898)	(0.104)			(1.713)	(1.29
Condo Conversion			113.769***	329.173***			−1.483	−50.473			23.771*	54.62
			(3.529)	(8.171)			(−0.077)	(−1.342)			(1.754)	(2.01
Contamination			−3.646	1.728			−111.47***	−299.91**			−21.297	89.99
			(−0.107)	(0.022)			(−2.665)	(−2.314)			(−0.390)	(0.56
Deed Restriction			22.205	41.994			−5.791	−34.403			−12.089	−23.
			(0.310)	(0.272)			(−0.139)	(−0.332)			(−0.271)	(−0.
Deferred Maintenance			−18.820**	−16.777			−13.628*	−46.282**			−4.725	29.99
			(−2.178)	(−0.859)			(−1.760)	(−2.180)			(−0.511)	(1.44
Distressed Sale			−22.638*	54.596*			−14.014	−11.250			−36.113***	294.8
			(−1.763)	(1.884)			(−1.106)	(−0.334)			(−3.219)	(19.1
Ground Lease			198.245***	1124.37***			20.439	146.538***			−6.794	−23.
			(6.779)	(31.395)			(1.350)	(5.091)			(−0.874)	(−2.
High Vacancy			28.940*	24.065			15.791*	290.697***			−43.030***	−105
			(1.806)	(0.884)			(1.709)	(14.170)			(−6.792)	(−7.
Historical			−18.316	−169.14***			−6.908	−124.44***			36.311*	118.8
			(−0.621)	(−3.091)			(−0.321)	(−2.636)			(1.929)	(4.08
Investor NNN			42.378***	62.423***			26.540***	13.666			25.036***	12.46
			(5.616)	(4.602)			(3.699)	(0.878)			(3.689)	(1.13
Land Contract			−14.621	−16.923			−13.066	−31.806			−20.190	−9.9
			(−0.703)	(−0.286)			(−0.472)	(−0.321)			(−0.260)	(−0.
Option Sale			15.502	14.846			3.270	−41.682			7.929	24.28
			(1.021)	(0.537)			(0.221)	(−1.234)			(0.587)	(1.06
Partial Interest			47.458**	1882.87***			−73.625***	−75.939			−70.599***	−191
			(2.422)	(65.175)			(−3.989)	(−1.630)			(−6.447)	(−19
Redevelopment			120.706***	398.490***			19.084	−1.517			−28.127**	−93.
			(7.463)	(18.248)			(1.463)	(−0.056)			(−2.299)	(−3.0
REO			−43.294***	−65.870**			−41.331***	−159.39***			−45.286***	−161
			(−4.033)	(−2.372)			(−3.911)	(−4.886)			(−3.950)	(−7.0
Sale Leaseback			1.421	−23.053			25.860***	38.725**			16.668**	−18.
			(0.189)	(−1.599)			(3.053)	(2.157)			(2.358)	(−1.
Shell Condition			29.552	18.483			−5.821	−18.665			−45.753**	−148
R Square	0.112	0.348	0.357	0.417	0.293	0.525	0.548	0.608	0.248	0.511	0.530	0.691
Model N	22,819	22,819	22,819	22,819	1,521	1,521	1,521	1,521	1,175	1,175	1,175	1,175
ESTAR-N	311	311	311	311	310	310	310	310	312	312	312	312
LEED N	93	93	93	93	35	35	35	35	30	30	30	30
Dual-N	32	32	32	32	71	71	71	71	192	192	192	192
Non-Eco-N	23,093	23,093	23,093	23,093	1,122	1,122	1,122	1,122	660	660	660	660
Prof Seller N	180	180	180	180	55	55	55	55	51	51	51	51
Prof Buyer N	434	434	434	434	211	211	211	211	204	204	204	204
Prof Both N	23	23	23	23	21	21	21	21	23	23	23	23
Sale Condition Controls			X	X			X	X			X	X
Weighting				X				X				X

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Variable	Smallest 1/3 ESTAR Buildings (<125,000 SF) Model1	Model2	Model3	Model4	Mid 1/3 ESTAR Buildings Model5	Model6	Model7	Model8	Largest 1/3 (>256,150 SF) Model9	Model10	Model11	Moc
			(1.524)	(0.593)			(−0.302)	(−0.433)			(−2.058)	(−2.5
Short Sale			−30.560	−73.853			−48.990	−153.56			−22.984	−39.
			(−0.990)	(−1.069)			(−1.644)	(−1.546)			(−0.552)	(−0.7
Single Tenant			8.239***	11.268**			8.620***	46.021***			6.939**	20.93
			(3.054)	(2.168)			(2.985)	(6.924)			(1.977)	(2.84
Tenant Purchase			−3.775	−7.907			18.168***	−0.167			25.398***	73.41
			(−0.551)	(−0.548)			(2.580)	(−0.010)			(2.982)	(5.28
R Square	0.112	0.348	0.357	0.417	0.293	0.525	0.548	0.608	0.248	0.511	0.530	0.691
Model N	22,819	22,819	22,819	22,819	1,521	1,521	1,521	1,521	1,175	1,175	1,175	1,175
ESTAR-N	311	311	311	311	310	310	310	310	312	312	312	312
LEED N	93	93	93	93	35	35	35	35	30	30	30	30
Dual-N	32	32	32	32	71	71	71	71	192	192	192	192
Non-Eco-N	23,093	23,093	23,093	23,093	1,122	1,122	1,122	1,122	660	660	660	660
Prof Seller N	180	180	180	180	55	55	55	55	51	51	51	51
Prof Buyer N	434	434	434	434	211	211	211	211	204	204	204	204
Prof Both N	23	23	23	23	21	21	21	21	23	23	23	23
Sale Condition Controls			X	X			X	X			X	X
Weighting				X				X				X

ESSAY 3

A New Paradigm

CoStar and the Matching Method

Abstract

This paper defined a new econometric method for assessing normal and abnormal returns for commercial real estate. The matching method uses appraisal based grid comparisons coupled with hedonic coefficient adjustments. This method was systematized and automated using the CoStar database. The matching method permits local comparisons of real estate assets rather than imposing national supply and demand parameters through hedonic regression. The theoretical development and empirical testing of these methods represent a new contribution in the commercial real estate literature.

1. Introduction

This paper developed and tested a new econometric method for assessing Commercial Real Estate (CRE) normal and abnormal returns. The methods outlined here offer an objective, repeatable methodology suitable for academic use. After outlining the theoretical model, results from nearly 20 Million iterations of empirical tests of the model are presented.

This paper expands potential academic methodology in commercial real estate beyond simple hedonic regression. The bulk of the extant academic real estate literature relied on forms of hedonic regression modeling, which are both powerful and useful (Malpezzi, 2002). Hedonic models estimate values for individual characteristics bundled together to form a good or service. Real estate estimations commonly use hedonic models; for example, the U.S. Consumer Price Index (CPI) uses them to estimate housing prices (Fixler, Fortuna, Greenlees, and Lane, 1999).

In standard CRE appraisals, real estate professionals use a series of comparables for each property. Generally, attributes like square feet, class, submarket, age and others provide the baseline to determine the appropriate data set. In individual appraisals, real estate professionals exercise expert judgment in the selection process. Mass data modeling on a national scale does not lend itself to hand selection of comparables. However, the data set CoStar provides can be used to create a matching methodology that reasonably approximates real estate practitioner methods, and creates a baseline normal estimation of expected returns.

Previous authors have examined alternative methods to hedonic regression for real estate estimation. Colwell, Cannaday, and Wu (1983) offered a systematic overview of the grid method for residential real estate. Kang and Reichert (1991) empirically tested the grid method combined with a hedonic regression for attribute adjustments in the residential sector. This paper extended the theoretical and empirical application of the grid method, which most closely mirrors practitioner appraisal techniques into the CRE arena.

2. Literature Review

Real Estate Finance, like other financial fields, endeavors to analyze assets objectively, consistently, and without error. This paper focuses on Commercial Real Estate (CRE) finance, using leasing and pricing data. Unfortunately, few models specifically apply to CRE, due to primarily to the dearth of available data. Corporate finance utilizes normative models based on the pioneering work of Markowitz (1952). Financial engineers use models such as Capital Assets Pricing Model (CAPM) (Lintner, 1965) and compare risk rewards based on Sharpe ratios (Sharpe, 1964). Positive models like Fama and French 3-Factor Model (Fama and French, 1993) and Arbitrage Pricing Theory (APT) are also used (Roll and Ross, 1980).

A wealth of objective data exists to value public corporate assets in equity price databases such as The Center for Research in Security Prices (CRSP) and financial statement databases such as Standard & Poor's Compustat.

In CRE, a dearth of publicly available databases minimizes the uniformity of modeling and wealth of empirical testing. In contrast to public stock prices, much of the CRE information is privately held. Some indices like National Council of Real Estate Investment Fiduciaries (NCREIF) and the American Council of Life Insurers (ACLI) provide information on private real estate. However, similar to CRSP, they tend to reflect pricing information with little in the way of explanatory or control variables. Issues such as price smoothing and information asymmetry exists in these indices (Fisher, Geltner, and Webb, 1994; Garmaise and Moskowitz, 2004).

National Association of Real Estate Investment Trusts (NAREIT) provides a Real Estate Investment Trust (REIT) index commonly used in the literature. Several other REIT indices also exist (e.g. MSCI REIT Preferred Index, Dow Jones Composite All REIT Index, FTSE NAREIT US and Global Real Estate Index Series), but they indirectly reflect property pricing through the REIT valuation. The correlation between returns on direct and indirect real estate investments has been typically found to be weak (Oikarinen, Hoesli, and Serrano, 2011).

This paper, through the matching method, estimated values in a manner most consistent with practitioner methods. In single site or single improvement valuation, appraisers/underwriters traditionally utilize the grid approach. The Appraisal Institute defines the grid method as a set of procedures in which a value indication is derived by comparing the property being appraised to similar properties that have been sold recently, applying appropriate units of comparison, and making adjustments to the sale prices of the comparables based on the elements of comparison (Appraisal Institute (U.S.) (2001): 63). They utilize standard comparison metrics like location, submarket, square feet, building class, etc.

In this approach the practitioner, hand selects a series (3-10) of comparables that they deem most like the subject property. However, personal judgment, and thus variation will enter the estimation process. In traditional grid methods, vague terms like "Superior" and "Inferior" connote a wide range of reasonable adjustments; they could reasonable mean as much as a 25% adjustment to price upwards or downwards.

Obviously, the hand selection of comparables will vary from person to person, and how they determine the underlying value of the varying CRE attributes will also be unique. As the number and complexity of leases increase, the degree of difficulty in accurately assessing value increases (Firstenberg, Ross, and Zisler, 1998). The lack of a uniform pricing mechanism creates information asymmetry, and inconsistent pricing in the market (Garmaise and Moskowitz, 2004). The appraisal based grid method's subjective nature makes it unsuitable for broad academic research, and created a need for consistent, repeatable tests in the literature.

In the past, many academics relied on hedonic regression, a form of ordinary least squares (OLS) where a product's attributes determine the overall value, to estimate premiums, abnormal returns, etc. Provided traditional OLS assumptions are in place, hedonic regression, as a form of OLS, yields consistent, unbiased estimations. However, in national CRE estimations, not all OLS assumptions, particularly the assumption of independence, may hold.

Also, when many dummy variable are included, regressions may suffer from the "incidental parameter" problem (Baltagi and Kao, 2001). When this occurs, dummy variables may become inconsistent. Not only can this raise issues through the market adjustments, but also when testing other dummy variables. The use of green real estate dummy variable are becoming common in the CRE literature.

The originally proposed hedonic model (Rosen, 1974) involved a two stage least squares (2SLS) where demand and supply were simultaneously estimated. Two stage regression involves the inclusion of an instrumental variable to complete the model. Wiley, Benefield, and Johnson (2010) estimated the traditional model in sustainable real estate by simultaneously estimating lease rates and occupancy rates. Occasionally, researchers use a three stage least squares (3SLS) to account for additional endogenous effects, e.g. (Clauretie and Daneshvary, 2011).

Although several authors expressed concern that a one-stage hedonic regression may be under-identified (Ekeland, Heckman, and Nesheim, 2002), researchers often estimated a one step hedonic regression; for example, the effect of a vector of attributes on sales price (Fuerst and McAllister, 2011). Hedonic regression captures the concept that buyers exhibit different preferences for the same product, and those buyer preferences may even vary across markets (Sirmans, Macpherson, and Zietz, 2005).

Many criticisms of hedonic estimations exist in the literature. Brown and Rosen (1982) expand on Rosen's original work suggesting that second stage estimation may not always yield new information. Specifically, they suggest in real estate related hedonic estimations, researchers may have to "impose the condition that the structural demand and supply parameters be identical across markets, even though the hedonic price loci are not."

In fact, current literature demonstrated that demand and supply parameters are not consistent from city to city in the form of fundamental supply/demand parameters and especially in cap rates[1] (Binkley and Ciochetti, 2010; Chichernea, Miller, Fisher, Sklarz, and White, 2008). Thus, in the context of a national CRE hedonic regression, it would inappropriate to impose homogeneous structural demand and supply across markets. Yet, this is exactly what virtually all the CRE literature has done, using only linear adjustments to the intercept in the form of market dummies.

[1]A cap rate, or capitalization rate is the discount rate used in valuing commercial real estate's current or predicted income as a perpetuity to establish current value.

Ekeland et al. (2002) argued that hedonic models in a single market were under-identified and empirical content derived from their use was inherently biased. Bowden (1992) outlined concerns that hedonic models were not fully identified in a market like real estate because price is a function of both buyer characteristics and building characteristics. Malpezzi (2002) concurred with potential specification problems in single stage hedonic regressions, and further argued that two-stage hedonic regression must be of different form to be estimable. In other words, models that involve a logarithmic first stage and a linear second stage may be estimable, but there will be issues when both stages are in logarithmic form. Epple (1987) suggested that the majority of hedonic models include endogenous variables, and may not produce consistent parameter estimates.

Another issue that arises in real estate estimations involves controlling for geographic dispersion in a national sample. Some authors argued for the use of spatial statistics to control for geographic dispersion (Pace and Gilley, 1998). Hayunga and Pace (2010) argued that real estate is a field built on the notion of location, yet the literature has not employed formal spatial techniques to examine the effects of geography on commercial property portfolios.

McDonald (2002) suggested that more studies were needed that dis-aggregated location and submarket. As noted above, the literature has clearly demonstrated cap rate diversity across metropolitan statistical areas (Chichernea et al., 2008; Hayunga and Pace, 2010). Whether hedonic regression controls such as cluster or submarket dummies adequately control for locational heterogeneity remains an open question.

2.1. Costar–Opening Modeling Doors

Recently CoStar opened its private CRE database to the academic world, and several journal articles appeared in such publication as American Economic Review, Journal of Real Estate Finance, and Real Estate Economics using this database (Eichholtz, Kok, and Quigley, 2010; Fuerst and McAllister, 2011). While not perfect, the CoStar database provides a consistent tool to estimate leasing and sales prices, and the attributes that determine price premiums.

Now that a universally available database exists for study, the primary question is how to best analyze the data.

Several authors have addressed weakness in the various real estate indices like NAREIT, NCREIF, and ACLI (Fisher, Gatzlaff, Geltner, and Haurin, 2003). As argued previously, limitations on the availability and reliability of property level Commercial Real Estate (CRE) data have constrained broad empirical testing of existing theories, and the development of new empirical methods (Fisher, 2002).

The matching method accounts for market and submarket issues by estimating expected returns using only properties within a market. This method provides unbiased estimates of both individual properties, and portfolio wide trends.

2.2. Grid Comparable Overview

The matching model's core characteristics originated from the Grid Comparable method. In individual real estate valuation, investors and appraisers hand select a set of comparable properties for valuation purposes (Colwell et al., 1983; Pace and Gilley, 1998). The process involves subjective selection of comparables, and subjective adjustment of the building characteristics.

Grid Method Example

To better understand the grid method, let us assume a fictional building lists for a $2,000,000 sales price. An appraiser, underwriter, or some real estate valuation expert hand selects a series of comparables which have recently sold in the market; for simplicity, let us assume three comparables are chosen. In general, comparables are selected from the same submarket to increase the level of spatial homogeneity. However, distinct locational difference still exist within any submarket, and need to be addressed.

When comparing location, unless attempting to integrate a mathematical spatial analysis (Dubin, Pace, and Thibodeau, 1999; Pace, Barry, and Sirmans, 1998), subjective adjustments again are used in the traditional grid method.

Further simplifying our example, we could assume all the sales were within a short period of time, avoiding the issue of time adjustments. Time from sale adjustments depended on whether a market is rising, falling or stable, and involved judgment on the pace of inflationary or deflationary pressures in the market. A grid was then developed which compares the building level attributes of the comparables to the subject buildings.

Table 1 shows the grid for our fictional subject and three comparables. Adjustments were made to the comparable sales prices in an attempt to equate the price of the comparables to that of the subject. For example, comparable one lists as containing 90,000 ft^2 and the subject as containing 100,000 ft^2. We therefore adjusted the price of comparable one upwards to price it *as if* it had 100,000 ft^2. Similarly, comparable two lists as containing 110,000 ft^2, so its price adjusted downward to make it *as if* it had 100,000 ft^2.

Table 1: Grid Comparison Method

Example of Grid Comparable

	Subject	Comparable 1		Comparable 2		Comparable 3	
Sale Price	$2,000,000	$1,900,000		$2,100,000		$2,050,000	
Square Feet	100,000	90,000	+$50,000	110,000	-$50,000	100,000	$0
Location		Superior	-$25,000	Inferior	+$35,000	Superior	-$50,000
Age	20 Yrs	10 Yrs	-$35,000	35 Yrs	+$25,000	5 Yrs	-$50,000
Building Class	Class A	Class B	+$20,000	Class A	$0	Class A	0
Amenities	Retail	None	+$35,000	Retail	$0	Retail and Bank	-$15,000
Net Adjustments			+$45,000		-$10,0000		-$115,000
Adj Price		$1,945,000		$2,090,000		$1,935,000	
Estimated Value[2]	$1,990,000						

Subjectivity enters the process when determining *how much* to adjust per square foot (PSF) (Geltner, 1989; Pagourtzi, Assimakopoulos, Hatzichristos, and French, 2003; Quan and Quigley, 1991). In this example, the valuer chose to adjust by $50 PSF based on their subjective expert knowledge of the market.

In traditional grid methods, vague terms like "Superior" and "Inferior" connote a wide range of reasonable adjustments. In this example, the range of adjustments went from -$50,000 to +$35,000.

Age of the building similarly can have subjective adjustment in a traditional grid method. Here, the range of adjustments was from -$50,000 to +$25,000. Generally, age of building depreciates in a non-linear fashion, and subjective measures may or may not fully capture this curve.

Incorporating local market knowledge, property specific knowledge, and potentially transaction level knowledge represent the primary advantages of subjective grid comparable method (Knight, Carter Hill, and Sirmans, 1993). However, the lack of consistent valuation metrics from expert to expert and the wide range of potential adjustments make it ill suited for academic studies.

The grid method provides the foundation for the more advanced models described here, which also incorporate hedonic modeling as a supporting technique.

Previous Attempts at Systematizing the Grid Method

Previous authors have attempted to systematize the comparison process. Isakson (1986) uses a "nearest neighbors" approach rather than an adjustment grid, based on the Mahalanobis distance of the various attributes.[3] The advantage of the method was that it relied on weighted averages of sales prices, and ignores the issue of characteristic level adjustments. The downside, as Vandell (1991) identified was that it lacked the ability to gauge the relative import of property level characteristics, or the degree

[3]The Mahalanobis distance D_{ij} is represented by the formula:

$$D_{ij} = \sqrt{(x_i - xj) \sum{}^{-1} (x_i - x_j)'}$$

where x_i and xj represent the vectors of standardized amenity coordinates for properties i and j and $\sum{}^{-1}$ is the variance-covariance matrix of the amenity coordinates for all properties.

of confidence in the magnitude of each adjustment factor. Vandell (1991) created a minimum variance method for grid weighting. These theoretical models primarily relied on residential real estate for any subsequent empirical testing.[4]

Isakson (1988) extended the nearest neighbor to a commercial real estate sample in Dallas, Texas. He had mixed results, finding some consistency in retail property evaluations, but not in office or industrial.

Hedonic Coefficient Adjustments and Weighting in Grid Methods

To the best of the author's knowledge, no other paper has approached CRE estimations using a grid method with hedonic adjustments. However, one prior article, using residential data, tested the grid method, enhanced with hedonic regression to provide adjustment metrics for the coefficients (Kang and Reichert, 1991).

Hedonic coefficient adjustment involves estimating the value for a metric like square feet from a hedonic regression. If the hedonic regression valued square feet at $10 PSF, then this value would be used to appropriately adjust the comparables.

Once the comparable set has been selected and the adjustment coefficients estimated, the model still must decide the optimal weighting scheme for the comparable set. In other words, in the vector of comparables C = $[X_1, ..., X_N]$ where X_1 represents comparable 1, and there are N comparables, the model still must determine the optimal W_i^* such that $[W_1^*\ X_1, ..., W_N^*\ X_N]$ represents the optimally weighted set.

Equally weighting each comparable may not be optimal because different properties may be more representative of the subject property. Colwell et al. (1983) provided the first notable discussion of the grid adjustment method. They examined three methods of adjustment characteristic values:

1. Additive Dollar Adjustment Method (ADAM),
2. Additive Percentage Adjustment Method (APAM),
3. Multiplicative Percentage Adjustment Method (MPAM).

As Colwell et al. (1983) outlined in their paper, the APAM method aligns with the

[4]One notable exception to this was Isakson (1988) who used Dallas, Texas CRE data.

log-linear model, the most commonly used form of hedonic real estate estimation. Lack of data availability represented the prior major constraint for hedonic price adjustment method in previous research (Colwell et al., 1983; Fisher et al., 2003; Lai and Wang, 1996). However, the availability of the CoStar national database provides ample data for empirical testing.

3. Model and Hypotheses Grid Comparable

Although adjusted for CRE, the model most closely follows Kang and Reichert (1991).

3.1. Data

The primary data source for this analysis came from CoStar.[5] CoStar is "the world leader for commercial real estate intelligence," and graciously provides their industry leading data free of charge to qualified university instructors and researchers.[6] CoStar contains over 2.8 Million US Commercial properties, including sales and leasing information. Data includes, but is not limited to location, physical buildings characteristics, tenants, and lease details.

3.2. Descriptive Statistics

The rent data was cleaned to include only data with a size and rent field existing. The data consisted of 48,733 rent observations across the top 50 Metropolitan Statistical Areas (MSA) (56 defined markets) in the United States; all rent observations are from Q4 2011. Descriptive statistics for key variables are shown in Table 2.

3.3. Basic Matching Model

The matching model created a repeatable and objective method, developed through an algorithmic process which yielded consistent test measures applicable to a wide

[5] Source: CoStar Group, Inc.

[6] See http://www.costar.com/specialprograms/costaruniversity.aspx for details on how to apply for access.

Table 2: This table shows basic descriptive statistics for the building population. The sample was drawn from CoStar. The rent sample is from Q4 2011. The top 50 MSA's (56 Markets) by human population during Q4 2011 were sampled. Rent is rent per square foot, size is in square feet, and age is years since construction.

Market	**N**	**Mean Size**	**Rent**	**Age**	**Market**	**N**	**Mean Size**	**Rent**	**Age**
Building Population	48,733	70,672	19	26	Milwaukee/Madison	569	54,861	14	33
Atlanta	1,742	78,704	16	22	Minneapolis/St Paul	1,009	84,177	13	30
Austin	560	61,619	17	20	Nashville	448	63,939	17	21
Baltimore	785	51,504	19	25	New Orleans	242	87,735	16	22
Birmingham	304	53,486	16	30	New York City	777	218,797	52	68
Boston	1,386	56,108	18	37	Northern New Jersey	1,723	56,018	20	27
Buffalo/Niagara Falls	188	55,405	14	36	Oklahoma City	269	63,380	14	27
Charlotte	651	72,528	17	20	Orange (California)	1,415	51,546	21	25
Chicago	2,606	97,882	17	26	Orlando	598	48,678	16	20
Cincinnati/Dayton	642	59,661	13	25	Philadelphia	1,661	73,087	18	27
Cleveland	652	68,624	14	30	Phoenix	1,471	55,265	18	20
Columbus	689	50,642	13	25	Pittsburgh	567	72,517	16	26
Dallas/Ft Worth	1,846	97,345	16	22	Portland	714	58,787	18	28
Denver	1,177	75,138	17	25	Providence	257	47,508	16	42
Detroit	1,300	61,628	15	26	Raleigh/Durham	519	45,164	17	17
East Bay/Oakland	676	58,254	21	30	Richmond VA	355	59,652	16	31
Hampton Roads	430	44,833	16	25	Sacramento	876	46,799	19	21
Hartford	384	64,416	17	34	Salt Lake City	423	55,543	16	25
Houston	1,323	113,418	17	22	San Antonio	444	60,195	17	27
Indianapolis	620	56,957	15	25	San Diego	983	51,303	22	24
Inland Empire (California)	801	31,493	17	19	San Francisco	538	110,658	31	36
Jacksonville (Florida)	397	54,191	16	21	Seattle/Puget Sound	1,187	65,783	19	25
Kansas City	804	59,003	16	29	South Bay/San Jose	617	52,784	24	29
Las Vegas	689	38,458	17	15	South Florida	1,945	59,343	19	22
Long Island (New York)	867	67,622	25	34	St. Louis	881	59,465	16	26
Los Angeles	2,447	80,940	26	28	Tampa/St Petersburg	769	53,190	16	22
Louisville	331	57,330	14	22	Washington DC	2,455	95,161	27	23
Marin/Sonoma	128	43,064	27	33	Westchester/So CT	319	73,601	24	33
Memphis	277	59,883	15	28					

variety of issues. It provides a new method to further advance the empirical testing of CRE.

The systematic matching was generated from the commercial real estate variables most significant in the selection process. The author performed a stepwise regression on lnrent (natural log of rent) for the entire database.[7] Results are shown in Table 3.

Table 3: This table shows results from a stepwise regression with the dependent variable of lnrent. The results are shown in decreasing importance to the dependent variable.

Step	**Variable**	**Partial R-Square**	**Cumulative R-Square**	**C(p)**	**F Value**	**Pr > F**
1	Lnsize	0.1155	0.1155	6705.9	6098.07	<.0001
2	NNN	0.0326	0.1481	4741	1785.72	<.0001
3	A Class	0.0221	0.1702	3411.9	1240.47	<.0001
4	B Class	0.0187	0.1889	2283.4	1077.91	<.0001
5	Percent Leased	0.0155	0.2044	1351.6	907.6	<.0001
6	Stories	0.0117	0.2161	647.61	696.47	<.0001
7	Lnage	0.0049	0.221	353.15	294.29	<.0001
8	FSG	0.0028	0.2238	187.41	167.1	<.0001

Based on the stepwise, and practitioner guidance the matching method first incorporates the following variables:

1. Submarket,
2. Size,
3. Class (A Class, B Class, C Class),
4. Rent.

Submarkets were included as a driving force behind the argument that matching may improve results from OLSDV with linear market adjustments. Size and building class were three of the top four variables from the stepwise regression. I did not

[7]The stepwise method used a forward selection method that adds variables to the model one by one, subject to an F test for variable significance. Potential issues with this method include some reliance on the order of inclusion. However, this method was used as a secondary objective method for variable inclusion, with primary focus on literature and practitioner guidance.

include the NNN[8] variable, because it might have limited the matching process more than necessary. However, the hedonic adjustment models still accounted for the rental difference between NNN and FSG through attribute adjustments.

I also included rent as a catch-all matching variable. A large dispersion indicated that the property was simply not a comparable for reasons not captured in the other controls; in other words, it may act as an outlier in rental estimations. As detailed later in the paper, categorical rankings were used to segment each market. Rent was separated into 20 categories, and the rent bound was plus or minus two categories, which encompassed 25% of the market. The rent parameter acted as a proxy for omitted variables, excluding buildings whose rent was clearly out of range to be an acceptable comparable; the 25% market band was selected to provide a wide range to generate sufficient comparables while still not biasing the results.

The N, or number of comparables, varied with each subject property. The minimum was set at 3; if less than three comparables existed, the subject property was excluded. The percentages of properties excluded by market varied, and is shown in Table 7. The maximum was set at 10. When more than 10 comparables were selected from the matching, they were narrowed to 10 based on the 10 least sum of squares difference method. That process is detailed in Equation 5

The basic model began with: $\mathrm{R}_{\mathrm{j}}^{S}$ defined as the rent for the subject, S, property j. For the sample used time was constant as Q4 2011.

First, a set of comparables, R_{j}^{C} for $\mathrm{R}_{\mathrm{j}}^{S}$ based on the vector, X_{i}, of control variables as discussed was determined. There were 3 to 10 (N) comparables for each each j^{th} observation, such that $\mathrm{R}_{j}^{C} = [\mathrm{R}_{1j}^{c}, \mathrm{R}_{2j}^{c}, ..., \mathrm{R}_{Ntj}^{c}]$. Where more than 10 comparables were drawn, I narrowed to 10 based on the lowest sum of squares difference from the subject.

Second, I estimated $Raw\_\hat{R}_{j}^{S}$ based on the average of the comparable set:

[8]NNN or Triple Net leases are lease types where the tenant pays a base rent and incurs all expenses. FSG or Full Service Gross leases are where the tenant pays a flat rent and the owner incurs all expenses. There is a spectrum of leases in between the two. Obviously, NNN rent would be less than FSG rent, ceterus paribus.

$$\hat{R}_j^S = \sum_1^N \frac{R_{nj}^c}{N} \tag{1}$$

Finally, to test whether the expected rent, $Raw\_\hat{R}_j^S$, was different from the observed rent, I performed a paired t-test for dependent populations.

$$t = \frac{\hat{D}}{\frac{\sigma_D}{\sqrt{N}}} \tag{2}$$

Where:

$\hat{D}$ represents the mean of differenced data set $(R_{\mathrm{j}}^S - Raw\_\hat{R}_{\mathrm{j}}^S)$

σ_D represents the standard deviation of differenced data set $(R_{\mathrm{j}}^S - Raw\_\hat{R}_{\mathrm{j}}^S)$

N represents the number of random draws being tested.

The paired t-test tests:

Hypothesis 1. $D_{Rj} = 0$

No difference exists between the observed R_j for a random sample of buildings and the estimated $\hat{R}_j$ from its comparable set of buildings using the basic matching method .

Note that a rejection of the null signifies failure of the model. The results that indicate successful estimation of expected rent would be T-Stats greater than -1.96 (5% confidence level) and less than 1.96 (5% confidence level), or failing to reject the null.

3.4. Matching Model with Hedonic Coefficient Adjustment / Grid Method

This method is a new contribution to the academic CRE literature. I used a combination of hedonic modeling and a matching model.

Following Kang and Reichert (1991), this method combined the two techniques and used regression to generate the adjustment coefficients used in the grid adjustment method.

First I used a market by market hedonic regression to estimate the appropriate attribute coefficients for each variable in each market. Each market was individually regressed on lnrent to establish values for building attributes in the specific market. The values by attribute were used for the creating the net adjustments in equation 3. Hedonic coeficient results are displayed across two tables, Tables 4 and 5.

Table 4: This table shows regression results for the random market subsets, consisting of 80% of the total market N of each market. Results are displayed across two tables. The remaining results are in Table 5. Lnrent was the dependent variable for all regressions.
***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

Market	**Intercept**	**lnsize**	**age100**	**age75**	**age50**	**age40**	**age30**	**age20**	**age15**	**age10**	**age5**
Atlanta	2.106***	0.039***	−0.048	−0.017	−0.227***	−0.136***	−0.212***	−0.200***	−0.025	−0.137***	−0.045
	(17.700)	(3.099)	(−0.542)	(−0.278)	(−3.820)	(−3.266)	(−6.535)	(−6.863)	(−0.531)	(−4.425)	(−1.391)
Austin	2.649***	0.005	−0.046	−0.005	0.082	−0.181**	−0.197***	−0.214***	0.002	−0.084**	−0.071*
	(14.501)	(0.249)	(−0.416)	(−0.033)	(0.872)	(−2.478)	(−4.358)	(−5.926)	(0.019)	(−2.090)	(−1.734)
Baltimore	2.388***	0.047***	−0.320***	−0.266***	−0.310***	−0.254***	−0.172***	−0.167***	−0.109*	−0.090*	−0.094**
	(13.205)	(2.596)	(−5.469)	(−4.544)	(−5.320)	(−4.766)	(−3.885)	(−4.427)	(−1.872)	(−1.807)	(−2.079)
Birmingham	2.122***	0.018	−0.070	−0.132	0.109	−0.158**	−0.107**	−0.046	0.030	0.082	0.100*
	(8.032)	(0.658)	(−1.020)	(−1.648)	(1.360)	(−2.435)	(−1.995)	(−0.994)	(0.350)	(1.331)	(1.677)
Boston	2.660***	−0.025	0.106**	0.102*	0.048	0.104*	0.033	0.021	−0.101	−0.048	0.044
	(15.287)	(−1.441)	(2.264)	(1.810)	(0.747)	(1.661)	(0.640)	(0.495)	(−0.955)	(−0.753)	(0.697)
Buffalo/Niagara Falls	2.953***	−0.057*	−0.113	−0.276**	−0.409***	−0.110	−0.116	−0.020	−0.022	−0.063	0.014
	(8.725)	(−1.661)	(−0.892)	(−2.536)	(−3.976)	(−0.964)	(−1.081)	(−0.209)	(−0.201)	(−0.598)	(0.137)
Charlotte	2.608***	−0.005	−0.400***	−0.225***	−0.148*	−0.207***	−0.262***	−0.208***	−0.227***	−0.171***	−0.099**
	(12.612)	(−0.249)	(−2.824)	(−3.090)	(−1.858)	(−3.155)	(−4.386)	(−4.499)	(−3.543)	(−3.738)	(−2.150)
Chicago	2.180***	0.043***	0.044	0.012	−0.071**	−0.067**	−0.127***	−0.112***	−0.077**	−0.103***	−0.035
	(23.019)	(4.367)	(1.328)	(0.367)	(−2.027)	(−2.186)	(−5.147)	(−4.718)	(−2.125)	(−3.271)	(−1.177)
Cincinnati/Dayton	2.328***	0.010	−0.227***	−0.354***	−0.382***	−0.390***	−0.188***	−0.187***	−0.193***	−0.150***	−0.072
	(10.474)	(0.437)	(−3.566)	(−5.209)	(−4.409)	(−5.150)	(−3.396)	(−3.799)	(−2.723)	(−2.679)	(−1.325)
Cleveland	2.081***	0.006	−0.060	−0.155*	−0.055	0.030	0.057	0.125*	0.004	0.169**	0.109
	(9.390)	(0.290)	(−0.789)	(−1.962)	(−0.690)	(0.405)	(0.825)	(1.964)	(0.045)	(2.374)	(1.483)
Columbus	2.091***	0.046**	−0.104	−0.298***	−0.261***	−0.266***	−0.278***	−0.300***	−0.114*	−0.181***	0.002
	(11.295)	(2.408)	(−1.556)	(−4.802)	(−4.158)	(−4.676)	(−5.545)	(−6.467)	(−1.701)	(−3.754)	(0.045)
Dallas/Ft Worth	2.591***	0.007	−0.122*	−0.144***	−0.267***	−0.245***	−0.304***	−0.310***	−0.229***	−0.165***	−0.066**
	(26.633)	(0.689)	(−1.783)	(−2.883)	(−5.483)	(−6.190)	(−10.230)	(−11.613)	(−3.692)	(−5.370)	(−2.258)
Denver	2.266***	0.063***	−0.084	−0.227***	−0.287***	−0.333***	−0.427***	−0.372***	−0.177**	−0.250***	−0.178***
	(16.374)	(4.576)	(−1.457)	(−2.921)	(−4.806)	(−6.246)	(−9.604)	(−8.729)	(−2.579)	(−5.541)	(−3.753)
Detroit	2.189***	0.037**	−0.288***	−0.153**	−0.169***	−0.133***	−0.144***	−0.072*	−0.030	−0.045	0.020
	(15.305)	(2.560)	(−3.778)	(−2.437)	(−2.832)	(−2.640)	(−3.218)	(−1.746)	(−0.455)	(−0.841)	(0.427)
East Bay/Oakland	2.640***	0.018	−0.042	−0.164**	−0.290***	−0.168**	−0.154**	−0.107*	−0.124	−0.258***	−0.147**
	(13.000)	(0.895)	(−0.292)	(−2.389)	(−3.384)	(−2.498)	(−2.464)	(−1.799)	(−1.468)	(−3.421)	(−1.976)
Hampton Roads	2.272***	0.031	−0.211***	−0.286***	−0.350***	−0.105	−0.218***	−0.162***	−0.225***	−0.157***	−0.098**
	(10.534)	(1.390)	(−2.915)	(−3.695)	(−4.623)	(−1.607)	(−4.734)	(−4.516)	(−3.280)	(−3.036)	(−2.292)
Hartford	3.022***	−0.046**	−0.093	−0.287***	−0.225***	−0.220***	−0.120*	−0.033	0.034	0.161	0.044
	(13.747)	(−2.117)	(−1.238)	(−3.885)	(−3.204)	(−3.223)	(−1.858)	(−0.619)	(0.230)	(1.574)	(0.503)
Houston	2.600***	0.007	−0.166	−0.226***	−0.294***	−0.277***	−0.308***	−0.281***	−0.159***	−0.111***	−0.086***
	(21.186)	(0.548)	(−1.032)	(−2.905)	(−5.539)	(−6.220)	(−9.707)	(−9.244)	(−2.670)	(−2.953)	(−2.593)
Indianapolis	2.465***	0.002	−0.196**	−0.086	−0.245***	−0.275***	−0.160***	−0.112**	−0.096	−0.053	−0.000
	(10.047)	(0.068)	(−2.334)	(−1.198)	(−2.668)	(−3.786)	(−3.116)	(−2.334)	(−1.376)	(−0.843)	(−0.007)
Inland Empire (California	2.280***	0.031	0.171	−0.071	−0.367***	−0.403***	−0.246***	−0.212***	−0.115*	−0.013	−0.068*
	(9.741)	(1.228)	(0.596)	(−0.420)	(−3.718)	(−5.005)	(−5.522)	(−6.527)	(−1.799)	(−0.114)	(−1.812)
Jacksonville (Florida)	3.253***	−0.059***	−0.249**	−0.195**	−0.075	−0.109	−0.180***	−0.206***	−0.131	−0.076	−0.009
	(15.534)	(−2.677)	(−2.417)	(−2.301)	(−0.941)	(−1.542)	(−3.098)	(−4.441)	(−1.646)	(−1.511)	(−0.197)
Kansas City	2.028***	0.051***	−0.273***	−0.238***	−0.285***	−0.262***	−0.161***	−0.166***	−0.077	−0.012	−0.005
	(11.665)	(2.788)	(−4.827)	(−4.405)	(−5.085)	(−5.076)	(−3.627)	(−4.048)	(−1.261)	(−0.234)	(−0.108)
Las Vegas	2.017***	0.105***	0.000	0.000	−0.539**	−0.316***	−0.483***	−0.347***	−0.224***	−0.193***	−0.107**
	(8.635)	(4.359)	(.)	(.)	(−2.433)	(−3.185)	(−7.217)	(−6.135)	(−3.875)	(−4.124)	(−2.301)

continued on next page

continued from previous page

Market	Intercept	lnsize	age100	age75	age50	age40	age30	age20	age15	age10	age5
Long Island (New York)	2.827***	0.004	0.142	0.129***	0.037	0.068	0.026	0.040	0.056	0.065	0.043
	(18.440)	(0.248)	(1.638)	(2.679)	(0.809)	(1.571)	(0.597)	(1.032)	(0.679)	(0.890)	(0.760)
Los Angeles	2.992***	0.003	−0.184	−0.156***	−0.096*	−0.208***	−0.201***	−0.253***	−0.193***	−0.097	−0.155**
	(21.407)	(0.185)	(−1.452)	(−2.602)	(−1.733)	(−3.831)	(−3.823)	(−4.979)	(−2.962)	(−1.405)	(−2.325)
Louisville	1.651***	0.069***	−0.239***	−0.245***	−0.178	−0.107	−0.077	−0.097	−0.017	−0.043	−0.098*
	(6.845)	(2.716)	(−3.742)	(−2.810)	(−1.515)	(−1.489)	(−1.387)	(−1.647)	(−0.203)	(−0.740)	(−1.681)
Marin/Sonoma	1.541***	0.105*	0.000	0.297	0.158	0.225**	0.094	0.112	−0.023	0.000	−0.059
	(2.869)	(1.937)	(.)	(1.658)	(1.058)	(2.057)	(0.896)	(1.124)	(−0.138)	(.)	(−0.317)
Memphis	1.989***	0.046	−0.750***	−0.500***	−0.251*	−0.377***	−0.393***	−0.248**	−0.132	−0.190*	−0.014
	(6.215)	(1.326)	(−5.203)	(−3.608)	(−1.873)	(−2.883)	(−3.517)	(−2.324)	(−0.827)	(−1.696)	(−0.122)
Milwaukee/Madison	2.314***	0.029	−0.112**	−0.277***	−0.138**	−0.146***	−0.105**	−0.101***	−0.113**	−0.017	0.033
	(13.096)	(1.648)	(−2.570)	(−5.512)	(−2.465)	(−2.879)	(−2.583)	(−2.973)	(−2.075)	(−0.394)	(0.766)
Minneapolis/St Paul	2.303***	0.019	−0.340***	−0.297***	−0.321***	−0.375***	−0.299***	−0.235***	−0.145*	−0.110**	−0.100**
	(14.261)	(1.139)	(−6.239)	(−5.150)	(−5.186)	(−7.395)	(−6.742)	(−5.747)	(−1.771)	(−2.390)	(−2.219)
Nashville	2.068***	0.050**	−0.273***	−0.077	−0.167**	−0.092	−0.125**	−0.168***	−0.223**	−0.098*	−0.016
	(9.307)	(2.105)	(−3.313)	(−0.851)	(−2.247)	(−1.087)	(−2.301)	(−3.707)	(−2.191)	(−1.934)	(−0.321)
New Orleans/Metairie/Ke	1.094***	0.153***	−0.264	0.000	−1.391***	−0.092	−0.039	−0.027	0.051	−0.438**	0.510*
	(2.803)	(3.725)	(−1.223)	(.)	(−4.535)	(−0.690)	(−0.471)	(−0.394)	(0.250)	(−2.135)	(1.785)
New York City	4.394***	−0.049*	−0.391*	−0.458**	−0.371*	−0.431**	−0.334	−0.387*	0.000	−0.547	−0.101
	(12.885)	(−1.804)	(−1.960)	(−2.300)	(−1.779)	(−1.991)	(−1.356)	(−1.755)	(.)	(−1.102)	(−0.350)
Northern New Jersey	2.707***	−0.001	−0.006	−0.046	−0.054	0.035	0.022	−0.001	−0.100	−0.019	0.095***
	(22.145)	(−0.088)	(−0.109)	(−1.078)	(−1.343)	(1.134)	(0.811)	(−0.049)	(−1.562)	(−0.420)	(2.632)
Oklahoma City	1.789***	0.084***	−0.234	−0.350**	−0.213**	−0.266***	−0.321***	−0.281***	0.315**	−0.035	−0.011
	(6.610)	(2.927)	(−1.526)	(−2.451)	(−2.048)	(−2.685)	(−3.841)	(−3.551)	(1.993)	(−0.340)	(−0.128)
Orange (California)	2.704***	0.005	−0.088	−0.338***	−0.051	−0.088	−0.101**	−0.133***	−0.106	−0.155***	−0.096*
	(15.050)	(0.262)	(−0.515)	(−3.085)	(−0.463)	(−1.642)	(−2.231)	(−3.025)	(−1.495)	(−2.952)	(−1.808)
Orlando	1.871***	0.077***	0.064	−0.121	−0.197**	−0.140*	−0.209***	−0.232***	0.135	−0.080	−0.014
	(8.133)	(3.125)	(0.330)	(−1.142)	(−2.377)	(−1.906)	(−3.701)	(−5.089)	(0.985)	(−1.619)	(−0.288)
Philadelphia	2.557***	0.010	−0.120***	−0.057	−0.053	0.035	−0.022	−0.012	0.065	0.046	0.096***
	(22.843)	(0.874)	(−2.964)	(−1.568)	(−1.537)	(1.024)	(−0.773)	(−0.475)	(1.392)	(1.189)	(2.816)
Phoenix	2.356***	0.034***	0.000	−0.105	−0.296***	−0.357***	−0.330***	−0.289***	−0.142**	−0.191***	−0.120***
	(20.974)	(2.994)	(.)	(−1.304)	(−5.107)	(−6.929)	(−10.781)	(−11.495)	(−2.323)	(−6.993)	(−4.562)
Pittsburgh	1.576***	0.067***	0.009	0.122**	0.018	0.033	0.003	0.070	0.207***	0.151**	0.141**
	(7.736)	(3.190)	(0.174)	(2.319)	(0.336)	(0.589)	(0.061)	(1.609)	(3.361)	(2.545)	(2.130)
Portland	2.927***	−0.016	−0.300***	−0.345***	−0.457***	−0.340***	−0.332***	−0.349***	−0.297***	−0.264***	−0.148***
	(16.039)	(−0.828)	(−5.214)	(−6.072)	(−7.331)	(−5.583)	(−6.859)	(−7.566)	(−4.899)	(−5.412)	(−3.051)
Providence	2.159***	0.056	−0.323***	−0.176	−0.083	−0.360***	−0.292***	−0.194**	−0.164	−0.195	−0.086
	(6.062)	(1.574)	(−3.288)	(−1.436)	(−0.719)	(−3.281)	(−2.824)	(−2.066)	(−1.075)	(−1.145)	(−0.817)
Raleigh/Durham	2.359***	0.033	0.126	−0.260***	−0.109	−0.165***	−0.277***	−0.197***	−0.229***	−0.177***	−0.092***
	(12.288)	(1.613)	(0.615)	(−2.765)	(−1.354)	(−2.884)	(−6.410)	(−5.484)	(−4.793)	(−5.240)	(−2.597)
Richmond VA	2.228***	0.036	−0.175***	−0.192***	−0.165**	−0.189***	−0.161***	−0.106***	0.071	−0.047	−0.025
	(10.950)	(1.625)	(−2.789)	(−3.005)	(−2.518)	(−3.254)	(−3.370)	(−2.655)	(1.075)	(−0.799)	(−0.451)
Sacramento	2.821***	−0.015	−0.153	−0.169**	−0.071	−0.125*	−0.174***	−0.186***	−0.054	−0.064	−0.081**
	(19.268)	(−0.984)	(−1.317)	(−2.194)	(−1.025)	(−1.954)	(−4.792)	(−5.975)	(−1.115)	(−1.605)	(−2.256)
Salt Lake City	2.030***	0.071***	−0.132*	−0.303***	−0.211**	−0.467***	−0.284***	−0.243***	−0.172***	−0.110***	−0.039
	(9.491)	(3.310)	(−1.697)	(−4.334)	(−2.560)	(−5.800)	(−6.499)	(−5.853)	(−3.011)	(−2.593)	(−0.744)
San Antonio	1.896***	0.082***	−0.343***	−0.127*	−0.144**	−0.232***	−0.162***	−0.137***	−0.049	−0.069	−0.034
	(10.417)	(4.426)	(−3.934)	(−1.793)	(−2.041)	(−4.226)	(−3.633)	(−3.546)	(−0.530)	(−1.224)	(−0.780)
San Diego	2.231***	0.065***	−0.034	0.071	−0.138	−0.011	−0.184***	−0.164***	−0.057	−0.052	−0.074
	(10.636)	(3.000)	(−0.238)	(0.638)	(−1.557)	(−0.167)	(−3.992)	(−3.881)	(−0.770)	(−0.937)	(−1.472)
San Francisco	2.649***	0.027	0.163	0.048	0.098	0.050	0.092	0.091	0.065	0.129	0.168

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Market	Intercept	lnsize	age100	age75	age50	age40	age30	age20	age15	age10	age5
	(7.827)	(0.807)	(1.582)	(0.457)	(0.840)	(0.462)	(0.892)	(0.942)	(0.289)	(1.098)	(1.341)
Seattle/Puget Sound	2.320***	0.057***	−0.257***	−0.288***	−0.326***	−0.252***	−0.224***	−0.235***	−0.226***	−0.188***	−0.153***
	(17.070)	(4.225)	(−4.794)	(−5.964)	(−5.961)	(−4.965)	(−5.386)	(−6.004)	(−4.028)	(−4.176)	(−3.369)
South Bay/San Jose	3.849***	−0.102***	0.018	−0.224	−0.027	0.046	−0.074	−0.038	0.342	−0.091	−0.024
	(11.193)	(−3.048)	(0.099)	(−1.276)	(−0.193)	(0.349)	(−0.608)	(−0.314)	(1.615)	(−0.631)	(−0.176)
South Florida	2.613***	0.026**	0.000	−0.070	−0.123***	−0.117***	−0.167***	−0.181***	−0.077*	−0.059*	0.007
	(21.076)	(2.057)	(.)	(−1.085)	(−2.769)	(−2.893)	(−5.372)	(−6.707)	(−1.646)	(−1.660)	(0.211)
St. Louis	2.314***	0.020	−0.332***	−0.285***	−0.218***	−0.288***	−0.204***	−0.191***	−0.155**	−0.158***	−0.069
	(12.756)	(1.074)	(−5.303)	(−4.375)	(−3.535)	(−5.032)	(−3.996)	(−4.084)	(−1.993)	(−3.177)	(−1.322)
Tampa/St Petersburg	1.844***	0.076***	−0.021	−0.094	−0.196***	−0.190***	−0.220***	−0.184***	−0.012	−0.054	−0.079
	(10.205)	(3.989)	(−0.187)	(−1.205)	(−2.640)	(−2.922)	(−4.194)	(−4.012)	(−0.142)	(−0.941)	(−1.446)
Washington DC	2.405***	0.035***	0.254***	0.213***	0.035	−0.011	−0.036	−0.082***	−0.015	−0.060*	0.004
	(21.442)	(3.086)	(5.269)	(4.176)	(0.846)	(−0.349)	(−1.253)	(−3.388)	(−0.330)	(−1.737)	(0.134)
Westchester/So Connecticu	2.822***	−0.011	−0.132	0.052	−0.078	−0.098	−0.107	−0.073	−0.067	−0.092	0.004
	(8.489)	(−0.323)	(−1.058)	(0.609)	(−0.874)	(−1.163)	(−1.396)	(−0.962)	(−0.533)	(−0.607)	(0.025)

Table 5: This table shows regression results for the random market subsets, consisting of 80% of the total market N of each market. Results are displayed across two tables. The first set of results are in Table 4. Lnrent was the dependent variable for all regressions.
***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

Market	Renovated	Percent Leased	stories	A Class	B Class	NNN	FSG	Amenity	ESTAR	LEED	Dual	R Square
Atlanta	0.068*	0.001***	0.004*	0.223***	0.079***	−0.003	0.199***	0.023	0.027	0.093	−0.014	0.358
	(1.779)	(4.738)	(1.950)	(5.748)	(3.489)	(−0.135)	(10.073)	(1.334)	(0.744)	(0.831)	(−0.246)	
Austin	0.001	0.001***	0.016***	0.189***	0.166***	−0.118***	0.130***	−0.015	0.011	−0.048	0.133	0.363
	(0.013)	(2.675)	(4.003)	(3.813)	(5.026)	(−3.680)	(3.851)	(−0.608)	(0.222)	(−0.428)	(1.642)	
Baltimore	−0.054	0.000	−0.003	0.280***	0.125***	−0.125***	0.131***	0.003	0.009	0.061	−0.086	0.441
	(−1.298)	(0.831)	(−0.965)	(6.713)	(4.589)	(−4.701)	(5.635)	(0.155)	(0.040)	(0.755)	(−0.522)	
Birmingham	−0.051	0.002***	0.005	0.297***	0.172***	0.122**	0.255***	0.048	−0.038	0.000	0.000	0.555
	(−0.852)	(3.042)	(0.804)	(4.406)	(4.813)	(2.175)	(7.367)	(1.018)	(−0.320)	(.)	(.)	
Boston	−0.055	0.001***	0.037***	0.378***	0.144***	−0.173***	−0.014	0.038	−0.099	0.275	0.048	0.250
	(−1.145)	(2.826)	(7.628)	(7.319)	(5.255)	(−5.593)	(−0.459)	(1.551)	(−1.133)	(1.590)	(0.246)	
Buffalo/Niagara Falls	0.070	0.001	0.011	0.482***	0.245***	−0.116*	0.110**	0.041	0.236	0.000	−0.450*	0.516
	(0.624)	(1.067)	(1.482)	(4.679)	(3.657)	(−1.758)	(2.111)	(0.834)	(1.066)	(.)	(−1.707)	
Charlotte	0.048	0.002***	0.009***	0.263***	0.142***	−0.059	0.096***	0.042	0.018	0.027	0.148	0.359
	(0.846)	(4.219)	(3.033)	(4.707)	(3.904)	(−1.426)	(2.961)	(1.329)	(0.348)	(0.241)	(1.245)	
Chicago	0.028	0.002***	0.004***	0.122***	0.080***	−0.140***	0.079***	0.026*	−0.020	0.171	0.045	0.240
	(1.134)	(6.860)	(3.827)	(4.307)	(5.045)	(−8.625)	(5.287)	(1.719)	(−0.633)	(1.495)	(0.982)	
Cincinnati/Dayton	0.116**	−0.000	0.009**	0.252***	0.189***	0.006	0.170***	0.022	−0.111	0.152	−0.115	0.305
	(2.181)	(−0.484)	(2.493)	(4.208)	(5.554)	(0.184)	(5.007)	(0.750)	(−1.171)	(1.119)	(−0.545)	
Cleveland	−0.033	0.002***	0.005	0.465***	0.275***	−0.074**	0.085***	0.013	0.042	0.488**	0.079	0.410
	(−0.499)	(3.942)	(1.362)	(7.345)	(8.083)	(−2.025)	(2.660)	(0.451)	(0.453)	(2.294)	(0.341)	
Columbus	−0.064	0.001***	0.002	−0.047	0.053**	−0.090***	0.136***	0.044*	0.085	0.000	−0.027	0.288
	(−1.206)	(2.935)	(0.589)	(−0.953)	(2.008)	(−3.391)	(5.072)	(1.945)	(0.828)	(.)	(−0.155)	
Dallas/Ft Worth	0.034	0.002***	0.003**	0.379***	0.175***	−0.113***	−0.003	0.023	0.036	0.075	0.202***	0.416
	(1.567)	(6.872)	(2.135)	(12.231)	(9.067)	(−5.867)	(−0.164)	(1.572)	(1.297)	(1.035)	(3.533)	
Denver	0.083***	0.001**	0.007***	0.203***	0.155***	−0.305***	−0.048*	−0.021	0.080**	0.082	0.086*	0.442
	(2.897)	(2.126)	(3.090)	(4.705)	(6.341)	(−9.927)	(−1.870)	(−1.137)	(2.522)	(1.018)	(1.900)	
Detroit	0.016	0.002***	0.001	0.252***	0.110***	−0.194***	−0.006	−0.019	0.066	0.000	0.000	0.241
	(0.430)	(6.080)	(0.202)	(5.334)	(4.570)	(−7.738)	(−0.203)	(−0.923)	(1.000)	(.)	(.)	
East Bay/Oakland	0.103*	0.002***	0.013***	0.096	0.009	0.055	0.144***	−0.020	0.081	0.227*	0.012	0.233
	(1.752)	(3.426)	(2.658)	(1.371)	(0.293)	(1.155)	(4.754)	(−0.754)	(1.361)	(1.799)	(0.135)	
Hampton Roads	−0.024	0.001	0.004	0.284***	0.157***	−0.045	0.169***	−0.005	0.051	−0.020	−0.167	0.475
	(−0.456)	(1.162)	(0.881)	(4.961)	(4.205)	(−1.121)	(5.789)	(−0.176)	(0.677)	(−0.130)	(−0.811)	
Hartford	−0.047	0.001***	0.007*	0.345***	0.157***	−0.119***	0.175***	−0.007	0.007	0.174	0.000	0.471
	(−0.833)	(2.771)	(1.664)	(5.258)	(4.554)	(−2.657)	(5.356)	(−0.204)	(0.068)	(0.716)	(.)	
Houston	0.043*	0.002***	0.008***	0.235***	0.113***	−0.031	0.178***	−0.012	0.044	0.036	0.035	0.347
	(1.902)	(5.266)	(4.961)	(6.871)	(5.512)	(−1.067)	(6.483)	(−0.588)	(1.533)	(0.399)	(0.677)	
Indianapolis	0.058	0.001**	0.006	0.295***	0.174***	−0.072	0.110***	0.022	−0.111	0.349	0.000	0.245
	(0.885)	(1.987)	(1.396)	(4.331)	(4.694)	(−1.571)	(3.258)	(0.735)	(−1.270)	(1.109)	(.)	
Inland Empire (California	−0.073	0.001*	0.053***	0.174***	0.086***	0.040	0.172***	0.017	−0.027	−0.122	0.000	0.301
	(−1.003)	(1.849)	(3.424)	(2.824)	(2.702)	(1.235)	(5.729)	(0.674)	(−0.354)	(−0.713)	(.)	
Jacksonville (Florida)	−0.015	−0.000	0.007*	0.379***	0.139***	−0.092***	0.167***	−0.009	−0.047	0.000	0.029	0.470
	(−0.303)	(−0.359)	(1.802)	(5.867)	(4.117)	(−2.681)	(4.676)	(−0.317)	(−0.471)	(.)	(0.182)	
Kansas City	−0.011	0.001**	−0.009**	0.373***	0.235***	−0.226***	0.164***	−0.004	−0.043	0.303**	−0.073	0.504
	(−0.285)	(2.094)	(−2.554)	(7.342)	(8.486)	(−5.480)	(6.195)	(−0.181)	(−0.603)	(2.088)	(−0.418)	
Las Vegas	0.074	0.000	0.018*	0.061	−0.062	−0.186***	0.156***	−0.102*	0.123	0.182	0.000	0.347
	(0.746)	(0.613)	(1.679)	(0.732)	(−1.139)	(−6.258)	(3.563)	(−1.862)	(0.694)	(1.179)	(.)	

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continued from previous page

Market	Renovated	Percent Leased	stories	A Class	B Class	NNN	FSG	Amenity	ESTAR	LEED	Dual	R Square
Long Island (New York)	−0.005	0.002***	0.017***	0.256***	0.118***	−0.004	−0.001	−0.086***	−0.094	−0.244	0.000	0.167
	(−0.130)	(3.621)	(4.065)	(5.343)	(4.394)	(−0.113)	(−0.036)	(−3.609)	(−0.794)	(−0.861)	(.)	
Los Angeles	0.123***	0.002***	−0.002	0.364***	0.156***	−0.036	0.063***	−0.053**	0.018	−0.013	0.124**	0.190
	(4.618)	(6.497)	(−1.210)	(10.805)	(7.075)	(−1.228)	(3.495)	(−2.526)	(0.623)	(−0.086)	(2.107)	
Louisville	0.175***	0.002***	−0.009	0.420***	0.191***	−0.125***	0.037	0.033	−0.016	0.230	0.000	0.458
	(2.692)	(2.724)	(−1.651)	(6.822)	(4.981)	(−2.646)	(0.966)	(0.963)	(−0.172)	(0.937)	(.)	
Marin/Sonoma	0.011	0.003**	−0.010	0.129	0.108	0.077	0.245***	0.019	0.318**	0.000	0.000	0.412
	(0.068)	(2.053)	(−0.250)	(0.860)	(1.471)	(0.630)	(3.135)	(0.234)	(2.021)	(.)	(.)	
Memphis	0.044	0.001*	0.003	0.208**	0.140**	−0.081	0.284***	0.088*	0.075	0.090	0.000	0.571
	(0.417)	(1.716)	(0.521)	(2.106)	(2.583)	(−1.191)	(5.610)	(1.676)	(0.369)	(0.299)	(.)	
Milwaukee/Madison	0.036	0.000	0.006*	0.169***	0.142***	−0.199***	0.109***	−0.050*	0.018	0.118	−0.059	0.340
	(0.948)	(0.088)	(1.834)	(3.052)	(4.929)	(−7.010)	(4.241)	(−1.734)	(0.307)	(0.923)	(−0.462)	
Minneapolis/St Paul	0.073*	0.002***	0.001	0.186***	0.038	−0.041*	0.307***	0.013	−0.007	−0.015	0.035	0.281
	(1.674)	(3.647)	(0.216)	(3.455)	(1.553)	(−1.671)	(11.227)	(0.447)	(−0.149)	(−0.077)	(0.403)	
Nashville	0.026	0.001*	0.001	0.251***	0.151***	−0.085**	0.099***	0.088***	0.018	0.130	0.011	0.438
	(0.537)	(1.677)	(0.135)	(4.283)	(4.229)	(−2.034)	(3.055)	(2.700)	(0.258)	(0.884)	(0.078)	
New Orleans/Metairie/Ke	0.017	0.000	−0.014**	0.138	0.113**	−0.035	0.051	−0.033	0.020	0.000	0.000	0.343
	(0.239)	(0.572)	(−2.166)	(1.195)	(2.296)	(−0.545)	(0.868)	(−0.679)	(0.132)	(.)	(.)	
New York City	0.098	0.004**	−0.004	0.511***	0.115**	0.163	−0.144	−0.037	0.036	0.567*	0.409**	0.156
	(1.414)	(2.224)	(−1.486)	(5.757)	(2.558)	(0.614)	(−1.152)	(−0.798)	(0.409)	(1.657)	(2.102)	
Northern New Jersey	0.057**	0.002***	0.017***	0.222***	0.087***	−0.119***	0.033	−0.028*	0.076	−0.082	0.000	0.200
	(2.195)	(5.501)	(4.753)	(7.186)	(4.681)	(−5.823)	(1.368)	(−1.676)	(1.259)	(−0.435)	(.)	
Oklahoma City	0.033	0.001*	−0.002	0.314***	0.126***	−0.213***	0.024	−0.041	−0.893***	0.000	0.000	0.433
	(0.467)	(1.696)	(−0.284)	(3.540)	(2.738)	(−3.190)	(0.543)	(−1.034)	(−3.044)	(.)	(.)	
Orange (California)	0.045	0.003***	0.012**	0.214***	0.071***	0.005	0.078***	−0.042*	0.043	0.256*	−0.138	0.170
	(1.206)	(6.423)	(2.156)	(4.548)	(2.668)	(0.177)	(3.350)	(−1.890)	(1.203)	(1.721)	(−1.617)	
Orlando	0.069	0.001***	0.020***	0.123**	0.024	−0.091***	0.090***	0.004	−0.101	−0.070	0.000	0.356
	(1.136)	(2.869)	(2.728)	(2.014)	(0.674)	(−2.680)	(2.742)	(0.136)	(−1.313)	(−0.364)	(.)	
Philadelphia	0.005	0.001***	0.005***	0.271***	0.140***	−0.223***	0.040*	0.049***	0.019	0.248*	0.061	0.315
	(0.197)	(2.727)	(2.601)	(9.552)	(7.242)	(−11.419)	(1.877)	(3.028)	(0.453)	(1.892)	(0.541)	
Phoenix	0.146***	0.001***	0.004	0.240***	0.160***	−0.098***	0.156***	−0.002	0.062*	−0.106	0.093	0.449
	(3.963)	(4.447)	(1.300)	(6.149)	(6.847)	(−4.154)	(8.106)	(−0.163)	(1.801)	(−1.187)	(1.143)	
Pittsburgh	0.044	0.001*	−0.001	0.392***	0.192***	0.051	0.149***	0.041	0.038	−0.099	0.000	0.456
	(0.999)	(1.948)	(−0.494)	(6.416)	(5.331)	(0.835)	(5.071)	(1.424)	(0.342)	(−0.532)	(.)	
Portland	0.107***	0.002***	0.011***	0.258***	0.122***	−0.060	0.108***	−0.016	0.069	0.034	−0.157	0.418
	(2.628)	(4.935)	(3.098)	(5.372)	(4.242)	(−1.630)	(3.634)	(−0.548)	(1.471)	(0.454)	(−1.231)	
Providence	−0.078	0.001	0.037***	0.355***	0.200***	−0.176***	0.042	−0.052	0.045	0.000	0.000	0.443
	(−0.863)	(0.821)	(2.930)	(2.645)	(3.806)	(−3.303)	(0.560)	(−0.861)	(0.141)	(.)	(.)	
Raleigh/Durham	0.077	0.000	0.007*	0.227***	0.144***	−0.051*	0.170***	−0.016	−0.027	−0.040	0.000	0.456
	(1.559)	(0.941)	(1.658)	(4.795)	(4.497)	(−1.707)	(6.226)	(−0.476)	(−0.433)	(−0.200)	(.)	
Richmond VA	0.138***	0.001*	0.003	0.217***	0.118***	−0.124***	0.077**	0.013	−0.026	0.000	0.000	0.482
	(3.580)	(1.718)	(0.738)	(3.974)	(3.576)	(−2.723)	(2.569)	(0.467)	(−0.441)	(.)	(.)	
Sacramento	0.108**	0.001***	0.023***	0.245***	0.191***	−0.215***	0.135***	0.021	0.081**	0.209	−0.043	0.467
	(2.188)	(3.179)	(5.056)	(5.948)	(8.755)	(−5.937)	(6.073)	(1.079)	(2.121)	(1.568)	(−0.513)	
Salt Lake City	0.045	−0.000	0.013***	0.184***	0.084**	−0.180***	0.057	−0.002	0.051	−0.036	0.163	0.564
	(0.727)	(−0.111)	(2.915)	(3.214)	(2.257)	(−3.925)	(1.307)	(−0.083)	(0.653)	(−0.167)	(0.787)	
San Antonio	0.001	0.000	−0.002	0.172***	0.067**	−0.047	0.176***	0.028	0.030	0.212	0.055	0.458
	(0.017)	(0.054)	(−0.610)	(3.103)	(2.400)	(−1.299)	(5.234)	(0.932)	(0.576)	(1.013)	(0.382)	
San Diego	−0.062	0.001**	−0.005	0.415***	0.220***	−0.081**	0.059**	−0.006	0.024	0.209	0.055	0.351
	(−1.525)	(2.498)	(−1.197)	(8.455)	(7.728)	(−2.403)	(2.073)	(−0.246)	(0.489)	(1.310)	(0.526)	
San Francisco	0.227***	0.001	0.005	0.123	0.088*	0.244***	0.065	0.049	0.054	0.137	0.141	0.189

continued on next page

continued from previous page

Market	Renovated	Percent Leased	stories	A Class	B Class	NNN	FSG	Amenity	ESTAR	LEED	Dual	R Square
	(2.859)	(1.281)	(1.286)	(1.482)	(1.699)	(3.705)	(1.446)	(1.070)	(0.718)	(0.649)	(1.547)	
Seattle/Puget Sound	0.073**	0.002***	0.003	0.172***	0.085***	−0.109***	0.133***	−0.016	0.044	0.059	−0.029	0.354
	(2.295)	(4.609)	(1.445)	(3.680)	(3.334)	(−4.119)	(5.112)	(−0.719)	(0.948)	(0.798)	(−0.471)	
South Bay/San Jose	−0.093	0.003***	0.022**	0.356***	0.182***	0.028	−0.001	−0.099**	0.249***	0.319	0.304	0.164
	(−0.872)	(3.615)	(2.067)	(3.238)	(3.858)	(0.447)	(−0.023)	(−2.455)	(2.852)	(1.415)	(1.495)	
South Florida	0.005	0.001**	0.016***	0.158***	0.038*	−0.182***	0.087***	0.026	−0.089**	−0.036	0.019	0.313
	(0.202)	(2.375)	(7.764)	(4.694)	(1.891)	(−9.522)	(4.261)	(1.451)	(−2.473)	(−0.351)	(0.257)	
St. Louis	0.037	0.001***	0.000	0.323***	0.132***	−0.166***	0.205***	0.090***	−0.034	0.120	−0.111	0.470
	(1.066)	(3.253)	(0.060)	(6.916)	(4.611)	(−4.573)	(7.077)	(3.708)	(−0.352)	(0.750)	(−0.404)	
Tampa/St Petersburg	0.025	0.001***	−0.000	0.182***	0.070***	−0.080**	0.172***	0.052**	0.047	0.000	0.041	0.424
	(0.659)	(2.595)	(−0.079)	(3.743)	(2.626)	(−2.504)	(6.529)	(2.236)	(0.707)	(.)	(0.287)	
Washington DC	0.012	0.001***	0.038***	0.177***	0.055**	−0.102***	0.103***	0.056***	0.072***	0.118**	0.112**	0.545
	(0.499)	(4.193)	(14.515)	(5.858)	(2.501)	(−4.638)	(6.492)	(3.608)	(3.008)	(2.469)	(2.366)	
Westchester/So Connecticu	0.041	0.002***	0.018*	0.374***	0.233***	−0.129*	−0.131	0.023	0.012	0.129	0.000	0.271
	(0.643)	(2.667)	(1.894)	(4.562)	(4.517)	(−1.851)	(−1.395)	(0.465)	(0.100)	(0.398)	(.)	

Second, I created a net adjustment factor (ANET_i), based on the closeness of fit for an observation to its potential pairs. The (ANET_i) was derived based on:

$$ANET_i = \sum |\beta_i (X_i^s - X_i^c)| \tag{3}$$

where

X_i	represents the i_{th} explanatory variable in the model
β_i	represents the regression-derived market value (hedonic price) for each property characteristic
s, c	stands for subject and comparable properties, respectively
j	indicates a specific comparable property.

In the third step, each comparable's price was adjusted based on the the comparables selected and the adjustment coefficients derived from the hedonic regression. This differed from the basic matching model in that the matching model assumed the the comparables were reasonable proxies for the subject buildings, and no attribute specific adjustment was made to estimate the predicted lease/sales price.

In this method, similar to traditional appraisal, each comparable's lease/sales price was adjusted based on the estimated weight of the attribute. For example, the hedonic regression might estimate SF to be worth an average of $50 PSF, thus the comparable would be adjusted upward or downward $50 for each SF it differed from the subject property as outlined in Table 1. In mathematical terms:

$$\hat{R}_j^s = R_j^c + NET_j = R_j^c + \sum |\beta_i (X_i^s - X_i^c)| \tag{4}$$

where

$\hat{R}_j^S$	represents the estimated rent of the subject property based upon comparable j
R_j^C	indicates the actual rent of the comparable property
NET_j	represents the net adjustment from the property including both positive and negative adjustments.

The fourth step estimated a single value for the subject property by taking a weighted average of the net adjustments.

3.5. Comparable Weighting

Up to this point, I have focused on how to adjust the property level characteristics in the comparables, but the effective and optimal weighting of the comparables merits its own discussion.

As Lin and Liao (2011) suggested, regression analysis yields property attribute adjustment coefficients, but was not designed to select the qualified comparables or assign the optimal weights. Colwell et al. (1983) discuss the five possible weighting schemes:

1. absolute value weighting,
2. quadratic or squared weighting,
3. statistical reliability,
4. distance-based weights,
5. a minimum or “no zero” weight technique.

They reached no conclusion regarding the theoretically optimal weighting scheme, but rather suggested that selection of weights is “a matter of judgment tempered by experience”. Kang and Reichert (1991) found the sum of squares method to be statistically reliable, and relied on it in their paper. The sum of squares method from Colwell et al. (1983) is:

$$w_j^* = \frac{\sum_{k=1}^{n}\sum_{i=1}^{m}(\beta_i(x_{is} - x_{ik}))^2 - \sum_{i=1}^{m}(\beta_i(x_{is} - x_{ij}))^2}{(n-1)\sum_{k=1}^{n}\sum_{i=1}^{m}(\beta_i(x_{is} - x_{ik}))^2} \tag{5}$$

where

w_j^*	= the optimal weighting for the jth comparable,
β_i	= the adjustment for factor the ith attribute,
$\sum_{k=1}^{n} \sum_{i=1}^{m} (\beta_i(x_{is} - x_{ik}))^2$	= the sum of the squared values of all adjustment made within a grid,
$\sum_{i=1}^{m} (\beta_i(x_{is} - x_{ij}))^2(n-1)$	= the sum of the squared values of all adjustment made for comparable j,
m	= the number of attributes for which adjustments are made, and
n	= the number of comparables

I followed the extant literature and used the sum of squares weighting for the hedonic adjustment. Employing the matching methodology with hedonic regression coefficient adjustments, I then updated equation 1 such that the optimal weighting w_j^* was incorporated.

$$\hat{R}_j^S = \sum_{1}^{N} \frac{w_j^* R_{nj}^c}{N} \tag{6}$$

With the proper weights I then computed D_{Rj}

$$R_j^S - \hat{R}_j^S = D_{Rj} \tag{7}$$

Finally, I used D_{Rj} as in the basic matching to examine the paired t-test equation 2.

The hypothesis tested was:

Hypothesis 2. $D_{Rj} = 0$

No difference exists between the observed R_j for a random sample of buildings and the estimated $\hat{R}_j$ from its comparable set of buildings using the matching method with hedonic coefficient adjustments.

Note that a rejection of the null signifies failure of the model. The results that indicate successful estimation of expected rent would be T-Stats greater than -1.96

(5% confidence level) and less than 1.96 (5% confidence level), or failing to reject the null.

3.6. Comparable Selection

The variable selection was described above. Now with sufficient background on the entire model, this section details the comparable selection process.

Comparables were first selected by matching the submarket cluster[9] to the submarket cluster of the subject property. In order to effectively compare different size and rent ranges, each market was divided into 20 different categorical sections. This method offered advantages over using percentages in that it narrowed the range of comparables in the middle sections. In order to be selected as a comparable, both size and rent were required to be plus or minus two categories. Thus, a building ranking in the 14th size category, could draw comparables from the 12th through the 16th size categories. In addition, the building had to be the same class (A Class, B Class).

The model selection went as follows:

1. Comparable submarket = Subject submarket,
2. Comparable Size - 2 <= Subject Size <= Comparable Size +2,
3. Comparable Rent - 2 <= Subject Rent <= Comparable Rent +2,
4. Comparable Building Class = Subject Building Class.

A building comparable had to meet all the criteria to be selected in the pool. In the first wave of tests, if the subject property did not generate at least 3 comparables, then it was excluded from the analysis. A second wave of tests was performed, where when a property did not generate at least 3 comparables, the building class requirement was dropped. This meant it drew from a wider pool of comparables, but possibly more unlike the subject. However, in the hedonic model, the expected rent should have been properly adjusted for class.

In the event there were more than ten comparables the sum of squares weighting method was used on the entire comparable set. Of the initial set, the top ten proper-

[9] As defined by The CoStar Group.

ties in terms of closeness of fit were kept, and the rest discarded. The sum of squares method was re-calculated for hedonic weighting based on the final ten comparables.

4. Testing the Models

I first created testable and holdout portions of the top 50 MSA's for validation testing. The testable portion consisted of randomly drawn 80% of the market, and the holdout was the remainder.

Testing the model on the testable portion consisted of 7 steps:

1. Select 5% of the market randomly.
2. For each property selected, determine its comparable set of 3-10 properties.
3. Estimate expected Rent for each property based on its comparables (Basic RHAT or Hedonic RHAT, depending on method).
4. Perform a paired T-Test for the entire set of observed rent and expected rent for the draw (e.g. for a market of 1,000 buildings, 50 properties would be selected, and the paired T-Test would test for differences between the expected and actual rent for the 50 properties collectively).
5. Repeat steps 1-4 a total of 500 times [10].
6. Examine the distribution of paired T-Tests from the 500 draws to determine if the model functions as expected.
7. Repeat steps 1-6 in several different iterations:
    (a) Using less stringent matching criteria where necessary:
        i. Using only coefficients with statistical significance of 10% or better,
        ii. Using only coefficients with statistical significance of 10% or better, excluding all green coefficients (ESTAR, LEED, Dual),[11]
        iii. Using all coefficients,

[10] Each full set of data testing took 5-7 days to complete. Each full market sample was comprised of roughly 2,000 randomly drawn properties, tested 500 times, for a total of 1 million tests. Each property averaged over 8 comparables, using roughly 8 million observations for each full set of 500 random draws. In addition, each full market samples was executed in four ways, for an approximate total of 4 Million subject properties compared to 32 Million comparables.

[11] Recent research by Robinson 2013 showed green variables may not be reliable market to market.

iv. Using all coefficients, except the green coefficients (ESTAR, LEED, Dual).

(b) Using more stringent matching criteria only:

i. Repeat steps i-iv above.

4.1. Selecting the Random Draw

The paired t-test for each market was based on a randomly drawn 5% of the testable portion. A market with 1,000 buildings would have 50 buildings randomly selected. Minneapolis makes a good sample market for illustrative purposes. Although its building N for the testable portion was actually 1,007, this discussion will treat it as 1,000 for explanatory purposes.

In any given draw of 50 buildings, each building could only be selected once. However, no constraints on future draws were placed. A building could theoretically be utilized in many or none of the 500 random samples.

Possible small sample properties

Once the building N drops below 600, the sample falls to less than 30 observations. At this point, the model could become less reliable due to an insufficient sample N. Results were still shown, but have been indicated on the table as potentially less reliable.

4.2. Comparables

Using the methods described above, a set of comparables was drawn for each of the 50 subject properties. If a property could not successfully generate a minimum of three comparables, it was excluded from the data set. Consequently, a draw of 50 properties may exclude 5 of them, and the paired T-Test would be on the 45 remaining in the sample.

4.3. Estimate Expected Rent

An $\hat{R}_j$ was created for each building based on both the basic and hedonic coefficient adjusted methods described in detail above. Each subject property was omitted from inclusion in its own comparable set. As noted earlier, each subject property could also only act as subject property once per draw. However, the data set available to draw comparables consisted of the entire testable population.

4.4. Perform Paired T-Test

After estimating the expected rent for each property in the randomly drawn sample, an array of observed and expected rent remained. Labeling S_n as the subject property observed rent, and $\hat{S}_n$ as the subject property expected rent, the following array would be observed:

$$\begin{bmatrix} S_1 & \hat{S}_1 \\ S_2 & \hat{S}_2 \\ .. & .. \\ S_{50} & \hat{S_{50}} \end{bmatrix}$$

The paired T-Test tested for a statistical difference between the two samples, as in Equation 2.

4.5. Repeat 1-4 a total of 500 times

Each market was queried 500 times to avoid a single sampling of buildings biasing the results. In any single draw, 50 properties in our example, buildings at the top or bottom of the rent distribution could create a sample where expected and observed rent are statistically significant. In five hundred samples, the expectation was that some of the samples would reject the null, or fail. If the model worked 90% of the time, then one would expect 10% of the time it would fail.

After repeating steps 1-4 for a total of 500 draws, an array of T-Tests was shown. Each of the 500 sets of from the Array above yielded a T-Test. This analysis yielded a new array of the T-Tests:

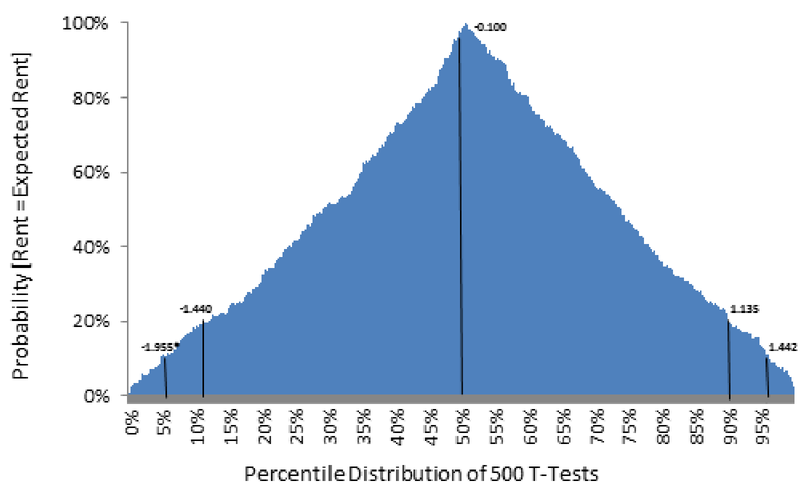
$$\begin{bmatrix} T_1 & T_2 & T_{...} & T_{500} \end{bmatrix}$$

4.6. Examine Distribution of T-Tests

The set of 500 paired T-Tests was ordered from smallest to largest. The most logical way to examine the data was to look at the distribution of the tails. If the 5th percentile and 95th percentile failed to reject the null, then the model worked on 90% of the draws.

The results the most rigorous test, shown in Table 12, have been presented graphically below:

Figure 1: This figure shows the distribution of T-Stats for 500 random draws of the Minneapolis market sorted from small to large. The 5th, 10th, median, 90th and 95th percentiles are shown.



Using the graph above as a guide, the upper tails of the distribution, the 95th and 90th percentiles, failed to reject the null of no difference at conventional levels. Thus the model effectively determined expected rent. At the lower end of the tails, the 10th percentile failed to reject, demonstrating model functioning. However, the 5th percentile did reject the null at a 10% significance level. Consequently, all draws below the 5th percentile rejected the null at a 10% or better significance level.

This shows the model worked as expected the vast majority of the time.

Since forecasting individual prices was not the model's purpose, examining the distribution of paired T-Tests provided valuable insight into whether the model could be used for academic research. However, the results suggest that the model also shows promise as a practitioner tool for estimating rental adjustments. The model's purpose was as an alternative to hedonic modeling for baseline normal and abnormal return estimations. Performing a series of large samples provided the optimal gauge of the model's empirical performance.

5. Results

The results presented a compelling case that for the use matching models, and matching with hedonic coefficient adjustments as methods to estimate an expected rent. In the great majority of cases, Hypothesis 1:

Hypothesis 1. $D_{Rj} = 0$

No difference exists between the observed R_j for a random sample of buildings and the estimated $\hat{R}_j$ from its comparable set of buildings using the basic matching method .

failed to be rejected at a 10% confidence level. Similarly, Hypothesis 2:

Hypothesis 2. $D_{Rj} = 0$

No difference exists between the observed R_j for a random sample of buildings and the estimated $\hat{R}_j$ from its comparable set of buildings using matching method with hedonic coefficient adjustments.

failed to be rejected at a 10% confidence level.

The first set of models, with more stringent matching criteria performed remarkably well on the lower end of the distribution. The model yielding the most consistent rejection of the null was the model using only the significant coefficients from the regression, followed closely by the similar model excluding the green components. Most markets detected no statistical difference between Hedonic RHAT and observed rent in the 5th percentile, and every market until the N dropped below 320 showed no difference in the 10th percentile. Performance at the upper tail was still strong, only 4 of the largest 44 markets showed a statistical difference greater than 5%, and over 80% of the markets showed no difference at all.

However, the upper portion of the rental distribution did not perform quite as well as the lower tails. This may have indicated increased heterogeneity in those markets at the upper distribution of rent and size. It could also have suggesed that the regression coefficients were a bit inconsistent in the tails.

Remarkably, the Basic RHAT, or the unweighted regressions, performed almost as well, and in some cases better. The portion where Basic RHAT outperformed the hedonic RHAT was in the upper portion of the rent distribution. This suggests that the regression coefficients from the hedonic coefficients were less effective at the upper portions of the rent distribution. This finding suggests that the matching process was functioning effectively. Note that the four different iterations were still relevant, because the sum of squares method to reduce comparables to a maximum of ten still incorporated the corresponding weighting.

In the following set of models, those where less stringent matching criteria was permitted when applicable, results were still solid. They remained reasonably consistent until the market N fell under 300, at which point a higher rejection rate was observed. Most likely, there were not sufficient comparables to effectively estimate rent in the lower N.

The overall results present a compelling case for using matching models plus incorporating hedonic coefficient adjustments for academic modeling. The vast majority of market samples, well over 90% in total, detected no statistical difference between expected rent using matching, and observed rent.

The results represent a significant contribution to the literature by demonstrating that the theoretical application of matching methods functions as an academic model. The control set shown in Table 20, which shows that smaller building consistently show less rent than larger buildings, demonstrates a simple application of the model in empirical studies.

Two summary tables are presented first. Table 6 summarizes the results from the detailed Tables 8 through 15. The percentages shown are the percent of the top 34 markets, those containing 600 or more buildings, that failed to reject the null hypothesis of no difference between observed and estimated rent. 600 N was chosen as the level where 5% of the market yielded 30 buildings. Falling under 30 observations may lead to small sample properties in T-Stat estimations.

Failure to reject the null hypothesis means model success. Results in 5th percentile mean that the corresponding percentage of markets rejected the null at the 5% or 10% significance level as shown in the table. For example, the first data point shows that using only the significant coefficients as the comparable selection method, 5.6% of markets rejected the null at 5% significance levels at the 5th percentile of their market distribution. Similarly, no market rejected the null at the 10th percentile of the t-test distribution. Zero percent rejection means the model successfully estimated rent for all markets on a statistical basis.

Rejection at the 10% level includes those markets that rejected at the 5% level as well. Summary results are shown for each model iteration

Table 6 showed a few key outcomes. The best performing models were those using only the significant coefficients. Excluding the green variables from the "all" coefficients model seemed to improve the model performance slightly. However, excluding green from the significant coefficients model deteriorated performance; note that green variables would only have been included if they were significant in that market's hedonic regression.

The second summary table, Table 7, shows the detail for the information used in the analysis. Each property could have selected up to 10 comparables, or as little as 3. The Mean Comps per property column shows the Mean comparables per property.

The Mean N for T-Test represents the average number of subjects with successful comparable selection per random draw. As noted, 5% of each market was drawn, but those properties with less than 3 comparables were disregarded. The Mean N column shows the average N used in the paired T-test for each market. Mean N % of draw represents the Mean N for T-Test as a percentage of the total properties drawn. An 80% number means that 20% of the properties selected did not successfully draw three or more comparables. All Mean N less than 30 were highlighted as potential small sample issues.

Table 6: This table summarizes the results of the distribution of T-Statistics displayed in Tables 8 through 15. The percentages shown are the percent of the top 34 markets, those containing 600 or more buildings, that failed to reject the null hypothesis of no difference between observed and estimated rent. Failure to reject means model success. Results in 5th percentile mean that the corresponding percentage of markets rejected the null at the 5% or 10% significance level as shown in the table. Rejection at the 10% level includes rejection at the 5% level as well. Zero percent rejection means the model successfully estimated rent for all markets on a statistical basis. Summary results are shown for each model iteration.

	Basic RHAT % failed to reject the null at 5% or better							
	Stringent Matching				Looser Matching			
	5th	10th	90th	95th	5th	10th	90th	95th
Sig. Coef. Only	5.9%	0.0%	0.0%	20.6%	0.0%	0.0%	2.9%	26.5%
Sig. Coef. -No Green	2.9%	0.0%	0.0%	17.6%	2.9%	0.0%	0.0%	23.5%
All Coef.	5.9%	0.0%	0.0%	17.6%	2.9%	0.0%	0.0%	14.7%
All Coef. No Green	5.9%	0.0%	5.9%	8.8%	5.9%	0.0%	0.0%	14.7%
	Basic RHAT % failed to reject the null at 10% or better							
Sig. Coef. Only	26.5%	0.0%	11.8%	82.4%	20.6%	0.0%	17.6%	61.8%
Sig. Coef. -No Green	20.6%	0.0%	14.7%	70.6%	20.6%	0.0%	17.6%	97.1%
All Coef.	44.1%	2.9%	5.9%	58.8%	38.2%	2.9%	8.8%	55.9%
All Coef. No Green	41.2%	2.9%	0.0%	64.7%	32.4%	0.0%	2.9%	47.1%
	Hedonic RHAT % failed to reject the null at 5% or better							
	Stringent Matching				Looser Matching			
Sig. Coef. Only	0.0%	0.0%	11.8%	29.4%	0.0%	0.0%	11.8%	23.5%
Sig. Coef. -No Green	0.0%	0.0%	11.8%	38.2%	0.0%	0.0%	8.8%	29.4%
All Coef.	5.9%	0.0%	0.0%	32.4%	2.9%	0.0%	2.9%	14.7%
All Coef. No Green	2.9%	0.0%	0.0%	29.4%	5.9%	0.0%	0.0%	17.6%
	Hedonic RHAT % failed to reject the null at 10% or better							
Sig. Coef. Only	23.5%	0.0%	23.5%	73.5%	23.5%	0.0%	29.4%	76.5%
Sig. Coef. -No Green	29.4%	0.0%	29.4%	82.4%	11.8%	2.9%	26.5%	32.4%
All Coef.	38.2%	5.9%	17.6%	79.4%	32.4%	2.9%	8.8%	55.9%
All Coef. No Green	26.5%	0.0%	29.4%	82.4%	32.4%	0.0%	2.9%	61.8%

Following the summary tables, the detailed results are reported. Tables 8 and 9 show results for Basic RHAT with less stringent matching. Tables 10 and 11 show results for Basic RHAT, or the unadjusted estimation of expected rent using only the first matching criteria. Tables 12 and 13 show the results for Hedonic RHAT with less stringent matching, when necessary. Tables 14 and 15 show the results for Hedonic RHAT, or the hedonic adjusted models using only the first matching criteria.

Table 7: This table summarizes the mean information used in the market analysis. The Mean Comps per property column represents the mean comparables used for each individual property. The Mean N for T-Test represents the average number of subjects with successful comparable selection per random draw. That N was used for the paired t-tests. % of Draw Matched represents the percentage of properties successfully paired with comparables per random draw. All Mean N less than 30 were highlighted as potential small sample issues.

		More Stringent Matching			Less Stringent Matching		
Market N	**Market Name**	Mean Comps per Property	Mean N for T-Test	% of Draw Matched	Mean Comps per Property	Mean N for T-Test	% of Draw Matched
2606	Chicago	8.47	83.17	85%	8.46	93.26	95%
2455	Washington DC	8.17	73	79%	8.06	83.2	90%
2447	Los Angeles	8.04	78.5	85%	8.16	87.06	95%
1945	South Florida	5.86	34.91	47%	5.87	49.24	67%
1846	Dallas/Ft Worth	7.29	53.66	77%	7.33	60.94	87%
1742	Atlanta	8.27	54.82	83%	8.44	60.67	92%
1723	Northern New Jersey	5.16	32.01	49%	5.55	48.06	74%
1661	Philadelphia	8.51	55.54	88%	8.59	60.18	96%
1471	Phoenix	7.61	47.36	85%	7.72	52.41	94%
1415	Orange (California)	8.55	46.8	87%	8.57	51.99	96%
1386	Boston	6.19	34.16	64%	6.45	46.01	87%
1323	Houston	5.71	**25.5**	51%	5.90	34.04	68%
1300	Detroit	6.28	31.62	65%	6.39	42.66	87%
1187	Seattle/Puget Sound	7.81	39.56	88%	8.02	43.79	97%
1177	Denver	7.22	31.1	69%	7.16	36.48	81%
1009	Minneapolis/St Paul	5.86	**21.41**	56%	6.21	**29.32**	77%
983	San Diego	7.35	**26.55**	72%	7.34	32.36	87%
881	'St. Louis'	6.64	**21.82**	66%	6.79	**28.36**	86%
876	Sacramento	7.84	**26.91**	82%	8.02	30.19	91%
867	Long Island (New York)	7.71	**24.89**	75%	7.82	**29.57**	90%
804	Kansas City	6.83	**19.06**	64%	6.78	**23.01**	77%
801	Inland Empire (California)	8.68	**27.5**	92%	8.88	**29.74**	99%
785	Baltimore	5.36	**14.41**	48%	5.56	**20.19**	67%
777	New York City	8.14	**23.19**	80%	8.25	**26.88**	93%
769	Tampa/St Petersburg	7.21	**20.56**	71%	7.13	**25.4**	88%
714	Portland	5.78	**15.8**	59%	5.97	**20.15**	75%
689	Columbus	6.22	**15.04**	58%	6.51	**20.86**	80%
689	Las Vegas	6.40	**18.28**	70%	6.43	**20.62**	79%
676	East Bay/Oakland	6.35	**15.94**	61%	6.28	**21.95**	84%
652	Cleveland	5.30	**11.61**	46%	5.36	**17.11**	68%
651	Charlotte	6.26	**13.66**	55%	6.13	**18.25**	73%
642	Cincinnati/Dayton	5.05	**12.09**	50%	5.49	**18.59**	77%
620	Indianapolis	6.33	**11.52**	48%	6.04	**17.01**	71%
617	South Bay/San Jose	5.21	**10.8**	47%	5.32	**16.08**	70%
598	Orlando	5.01	**5.64**	25%	5.42	**8.1**	35%
569	Milwaukee/Madison	6.50	**16.28**	74%	6.74	**20.12**	91%
567	Pittsburgh	5.74	**8.32**	38%	5.49	**12.43**	57%
560	Austin	6.21	**9.5**	45%	5.89	**12.12**	58%
538	San Francisco	6.04	**10.7**	51%	6.27	**14.25**	68%
519	Raleigh/Durham	6.33	**11.87**	59%	6.30	**16.15**	81%
448	Nashville	5.30	**7.1**	42%	5.27	**9.3**	55%
444	San Antonio	5.98	**9.72**	57%	6.37	**12.18**	72%
430	Hampton Roads	7.89	**13.55**	85%	7.94	**15.35**	96%
423	Salt Lake City	5.55	**9.69**	61%	5.69	**11.56**	72%
397	Jacksonville (Florida)	5.22	**4.73**	32%	5.27	**7.2**	48%
384	Hartford	4.99	**5.62**	37%	5.17	**9.25**	62%
355	Richmond VA	7.07	**8.76**	63%	6.76	**10.87**	78%
331	Louisville	5.19	**2.96**	23%	4.68	**5.12**	39%
319	Westchester/So Connecticut	5.17	**2.17**	18%	4.58	**3.29**	27%
304	Birmingham	5.19	**5.32**	48%	5.01	**8.17**	74%
277	Memphis	4.89	**3.19**	32%	4.69	**4.69**	47%
269	Oklahoma City	6.77	**7.71**	77%	7.24	**8.71**	87%
257	Providence	4.96	**2.57**	26%	4.58	**5.2**	52%
242	New Orleans/Metairie/Kenner	4.07	**2.42**	27%	4.57	**4.95**	55%
188	Buffalo/Niagara Falls	3.25	**1.35**	19%	3.11	**1.88**	27%
128	Marin/Sonoma	5.11	**3.03**	61%	5.24	**4.39**	88%

Table 8: This table shows the distribution of T-statistics from 500 random draws of 5% of each market for Basic RHAT, or estimated rent without attribute adjustments. Results are for adjustments based on the first, and less stringent matching criteria if necessary, and using comparable selection based on sum of squares from only significant coefficients with and without Green variables are shown. The results using hedonic adjustments from all coefficients, as opposed to only significant, are shown in Table 9. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

		Percentile for Sig. Coef.					Percentile for Sig. Coef. No Green				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
2606	Chicago	−1.443	−1.200	0.035	1.411	1.640	−1.428	−1.125	0.182	1.414	1.776*
2455	Washington DC	−1.628	−1.289	−0.217	1.102	1.528	−1.595	−1.241	−0.011	1.306	1.585
2447	Los Angeles	−1.920*	−1.631	−0.248	0.931	1.302	−1.795*	−1.485	−0.226	1.031	1.491
1945	South Florida	−1.568	−1.285	0.072	1.408	1.883*	−1.501	−1.153	0.113	1.344	1.711*
1846	Dallas/Ft Worth	−1.430	−1.145	−0.114	1.542	1.815*	−1.438	−1.266	−0.109	1.285	1.723*
1742	Atlanta	−1.365	−1.095	0.243	1.801*	2.277**	−1.314	−1.046	0.134	1.651*	1.940*
1723	Northern New Jersey	−1.411	−1.170	0.066	1.439	1.820*	−1.458	−0.968	0.188	1.554	1.960**
1661	Philadelphia	−1.556	−1.240	−0.261	1.273	1.741*	−1.561	−1.312	−0.148	1.394	1.821*
1471	Phoenix	−1.609	−1.383	−0.266	1.252	1.546	−1.593	−1.366	−0.206	1.203	1.522
1415	Orange (California)	−1.493	−1.146	0.176	1.459	1.808*	−1.602	−1.135	0.211	1.465	1.819*
1386	Boston	−1.723*	−1.387	−0.060	1.316	1.602	−1.765*	−1.420	−0.120	1.139	1.365
1323	Houston	−1.414	−1.112	0.027	1.334	1.607	−1.551	−1.252	0.100	1.349	1.607
1300	Detroit	−1.343	−1.069	0.016	1.589	1.984**	−1.478	−1.152	0.100	1.715*	2.213**
1187	Seattle/Puget Sound	−1.523	−1.211	0.046	1.482	1.869*	−1.541	−1.310	−0.154	1.323	1.576
1177	Denver	−1.363	−1.082	0.025	1.264	1.543	−1.513	−1.279	−0.049	1.357	1.835*
1009	Minneapolis/St Paul	−1.733*	−1.476	0.058	1.256	1.582	−1.692*	−1.409	−0.050	1.182	1.504
983	San Diego	−1.389	−1.043	0.229	1.565	1.970**	−1.269	−0.935	0.192	1.583	1.883*
881	'St. Louis'	−1.453	−1.277	−0.049	1.382	1.737*	−1.462	−1.296	−0.104	1.362	1.665*
876	Sacramento	−1.230	−0.905	0.282	1.747*	2.178**	−1.260	−0.976	0.227	1.779*	2.043**
867	Long Island (New York)	−1.498	−1.216	0.168	1.410	1.653*	−1.548	−1.266	0.151	1.357	1.655*
804	Kansas City	−1.283	−1.010	0.145	1.577	1.988**	−1.286	−1.100	0.071	1.653*	2.160**
801	Inland Empire (California)	−1.488	−1.258	−0.102	1.509	1.844*	−1.318	−1.152	0.049	1.439	1.835*
785	Baltimore	−1.618	−1.310	−0.069	1.182	1.589	−1.552	−1.157	−0.071	1.250	1.606
777	New York City	−1.922*	−1.614	0.182	1.196	1.424	−2.003**	−1.612	0.132	1.153	1.366
769	Tampa/St Petersburg	−1.069	−0.901	0.399	1.986**	2.339**	−1.248	−1.060	0.275	1.743*	2.173**
714	Portland	−1.391	−1.178	0.118	1.640	1.935*	−1.342	−1.120	0.112	1.586	2.008**
689	Columbus	−1.720*	−1.361	−0.269	1.146	1.498	−1.832*	−1.388	−0.085	1.218	1.596
689	Las Vegas	−1.312	−1.032	0.164	1.550	2.034**	−1.371	−1.043	0.247	1.664*	2.065**
676	East Bay/Oakland	−1.430	−1.058	0.087	1.690*	2.029**	−1.417	−1.149	0.071	1.469	1.743*
652	Cleveland	−1.350	−1.084	0.275	1.691*	1.950*	−1.497	−1.109	0.191	1.512	1.747*
651	Charlotte	−1.190	−0.912	0.380	1.674*	1.962**	−1.463	−1.052	0.373	1.629	2.014**
642	Cincinnati/Dayton	−1.337	−1.128	−0.006	1.612	1.897*	−1.437	−1.128	0.017	1.558	1.952*
620	Indianapolis	−1.654*	−1.269	0.040	1.277	1.492	−1.840*	−1.484	−0.097	1.184	1.502
617	South Bay/San Jose	−1.653*	−1.399	−0.102	1.208	1.603	−1.696*	−1.342	−0.031	1.340	1.652*
		*Small sample issues possible below 600 N									
598	Orlando	−1.472	−1.190	0.180	1.512	1.846*	−1.524	−1.123	0.282	1.699*	1.967**

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		Percentile for Sig. Coef.					Percentile for Sig. Coef. No Green				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
569	Milwaukee/Madison	−1.536	−1.319	0.003	1.448	1.725*	−1.449	−1.220	−0.021	1.456	1.824*
567	Pittsburgh	−1.377	−1.114	0.168	1.528	1.905*	−1.541	−1.157	0.187	1.531	1.827*
560	Austin	−2.074**	−1.589	−0.175	1.227	1.571	−1.892*	−1.542	−0.168	1.186	1.540
538	San Francisco	−1.579	−1.132	0.101	1.512	1.782*	−1.690*	−1.378	0.030	1.299	1.533
519	Raleigh/Durham	−1.359	−1.074	0.050	1.535	1.832*	−1.414	−1.159	0.105	1.225	1.697*
448	Nashville	−1.578	−1.264	−0.211	1.510	1.837*	−1.810*	−1.419	−0.307	1.298	1.681*
444	San Antonio	−1.538	−1.160	0.119	1.399	1.671*	−1.626	−1.298	0.217	1.502	1.800*
430	Hampton Roads	−1.817*	−1.489	−0.333	1.091	1.581	−1.812*	−1.488	−0.222	1.231	1.637
423	Salt Lake City	−1.527	−1.253	−0.014	1.293	1.655*	−1.531	−1.256	0.098	1.362	1.811*
397	Jacksonville (Florida)	−1.611	−1.240	−0.013	1.548	1.979**	−1.689*	−1.376	−0.104	1.470	1.972**
384	Hartford	−1.833*	−1.350	0.027	1.388	1.743*	−1.729*	−1.356	−0.028	1.269	1.727*
355	Richmond VA	−1.572	−1.260	−0.027	1.451	1.921*	−1.623	−1.395	0.093	1.429	1.649*
331	Louisville	−1.823*	−1.373	0.238	1.463	1.913*	−2.100**	−1.532	0.056	1.490	2.098**
319	Westchester/So Connecticut	−2.379**	−1.730*	−0.193	1.452	2.044**	−2.345**	−1.669*	−0.295	1.412	1.933*
304	Birmingham	−1.359	−1.102	0.061	1.748*	2.102**	−1.223	−0.969	0.201	1.624	2.131**
277	Memphis	−1.898*	−1.445	−0.078	1.481	1.987**	−2.139**	−1.513	−0.013	1.689*	2.559**
269	Oklahoma City	−1.058	−0.880	0.602	1.996**	2.382**	−1.253	−0.958	0.555	1.900*	2.214**
257	Providence	−2.192**	−1.428	0.048	1.467	1.940*	−2.624***	−1.699*	−0.155	1.433	1.776*
242	New Orleans/Metairie/Kenner	−1.722*	−1.346	0.038	1.510	1.886*	−1.622	−1.269	0.132	1.698*	2.177**
188	Buffalo/Niagara Falls	−3.818***	−1.869*	−0.262	2.167**	4.566***	−2.418**	−1.639	−0.216	1.953*	4.034***
128	Marin/Sonoma	−1.855*	−1.493	−0.164	1.636	2.327**	−1.636	−1.333	−0.109	1.435	1.974**

Table 9: This table shows the distribution of T-statistics from 500 random draws of 5% of each market for Basic RHAT, or estimated rent without attribute adjustments. . Results are for adjustments based on the first, and less stringent matching criteria if necessary, and using comparable selection based on sum of squares from all coefficients with and without Green variables are shown. The results from using only significant coefficients for hedonic adjustment, as opposed to all coefficients, are shown in Table 8. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

		Percentile for All Coef. No Green					Percentile for All Coef.				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
2606	Chicago	−1.685*	−1.343	−0.159	1.144	1.465	−1.714*	−1.371	−0.149	1.206	1.454
2455	Washington DC	−1.939*	−1.595	−0.415	0.897	1.340	−1.915*	−1.614	−0.400	0.952	1.340
2447	Los Angeles	−1.972**	−1.628	−0.274	0.935	1.266	−1.973**	−1.627	−0.293	1.068	1.462
1945	South Florida	−1.506	−1.167	0.148	1.415	1.825*	−1.446	−1.203	0.015	1.318	1.823*
1846	Dallas/Ft Worth	−1.569	−1.242	−0.170	1.296	1.697*	−1.482	−1.225	−0.190	1.082	1.485
1742	Atlanta	−1.374	−1.199	−0.089	1.526	1.800*	−1.460	−1.190	−0.126	1.390	1.745*
1723	Northern New Jersey	−1.215	−0.894	0.165	1.569	2.004**	−1.438	−1.115	0.147	1.621	1.944*
1661	Philadelphia	−1.494	−1.238	−0.106	1.461	1.911*	−1.500	−1.303	−0.207	1.413	1.810*
1471	Phoenix	−1.631	−1.383	−0.301	1.057	1.477	−1.669*	−1.446	−0.457	1.094	1.492
1415	Orange (California)	−1.564	−1.211	0.057	1.240	1.519	−1.639	−1.298	−0.006	1.267	1.543
1386	Boston	−1.716*	−1.451	−0.189	1.234	1.535	−1.667*	−1.387	−0.050	1.158	1.409
1323	Houston	−1.657*	−1.308	−0.055	1.453	1.761*	−1.510	−1.247	0.120	1.418	1.743*
1300	Detroit	−1.359	−1.154	0.026	1.574	1.967**	−1.340	−1.146	−0.041	1.593	1.992**
1187	Seattle/Puget Sound	−1.743*	−1.550	−0.339	1.200	1.481	−1.780*	−1.501	−0.344	1.131	1.557
1177	Denver	−1.486	−1.240	−0.072	1.243	1.556	−1.665*	−1.354	−0.000	1.320	1.717*
1009	Minneapolis/St Paul	−1.638	−1.320	−0.052	1.207	1.476	−1.824*	−1.621	−0.172	1.175	1.468
983	San Diego	−1.421	−1.126	0.181	1.550	1.935*	−1.498	−1.159	0.163	1.559	2.073**
881	'St. Louis'	−1.623	−1.313	−0.060	1.370	1.735*	−1.460	−1.232	−0.286	1.337	1.626
876	Sacramento	−1.414	−1.171	0.014	1.481	1.898*	−1.437	−1.166	0.047	1.661*	2.043**
867	Long Island (New York)	−1.427	−1.121	0.142	1.403	1.689*	−1.511	−1.159	0.150	1.523	1.739*
804	Kansas City	−1.471	−1.157	−0.014	1.447	1.929*	−1.438	−1.226	−0.037	1.540	1.914*
801	Inland Empire (California)	−1.533	−1.147	0.009	1.558	1.893*	−1.390	−1.122	0.121	1.590	1.859*
785	Baltimore	−1.744*	−1.426	0.019	1.286	1.538	−1.797*	−1.362	0.058	1.318	1.570
777	New York City	−1.967**	−1.565	0.188	1.193	1.442	−1.926*	−1.645*	0.020	1.129	1.362
769	Tampa/St Petersburg	−1.307	−1.039	0.223	1.642	2.030**	−1.153	−0.963	0.264	1.656*	2.058**
714	Portland	−1.535	−1.240	−0.070	1.424	1.755*	−1.390	−1.164	0.117	1.481	1.746*
689	Columbus	−1.734*	−1.334	−0.181	1.192	1.480	−1.669*	−1.399	−0.343	1.034	1.308
689	Las Vegas	−1.329	−1.079	0.217	1.648*	2.063**	−1.376	−1.114	0.231	1.735*	2.222**
676	East Bay/Oakland	−1.380	−1.076	0.070	1.457	1.847*	−1.483	−1.186	−0.129	1.490	1.861*
652	Cleveland	−1.529	−1.166	0.241	1.614	1.866*	−1.522	−1.204	0.185	1.436	1.754*
651	Charlotte	−1.403	−0.995	0.429	1.578	1.890*	−1.253	−1.045	0.275	1.607	1.911*
642	Cincinnati/Dayton	−1.470	−1.200	−0.031	1.529	1.987**	−1.414	−1.121	−0.053	1.496	1.798*
620	Indianapolis	−1.731*	−1.460	−0.033	1.244	1.502	−1.787*	−1.504	−0.089	1.194	1.480
617	South Bay/San Jose	−1.751*	−1.300	−0.119	1.413	1.781*	−1.738*	−1.464	−0.200	1.154	1.460
		*Small sample issues possible below 600 N									
598	Orlando	−1.444	−1.122	0.276	1.596	1.868*	−1.547	−1.270	0.237	1.665*	1.994**

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		Percentile for All Coef. No Green					Percentile for All Coef.				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
569	Milwaukee/Madison	−1.433	−1.162	0.057	1.497	1.902*	−1.546	−1.214	−0.002	1.468	1.685*
567	Pittsburgh	−1.371	−1.060	0.251	1.416	1.707*	−1.372	−1.029	0.337	1.547	1.903*
560	Austin	−2.012**	−1.665*	−0.233	1.200	1.557	−2.001**	−1.560	−0.221	1.083	1.492
538	San Francisco	−1.532	−1.198	0.047	1.399	1.765*	−1.556	−1.211	0.014	1.355	1.619
519	Raleigh/Durham	−1.599	−1.183	0.118	1.397	1.763*	−1.537	−1.195	0.039	1.432	1.786*
448	Nashville	−1.716*	−1.335	−0.106	1.471	1.883*	−1.636	−1.308	−0.203	1.273	1.674*
444	San Antonio	−1.753*	−1.190	0.228	1.363	1.631	−1.465	−1.126	0.166	1.446	1.708*
430	Hampton Roads	−1.934*	−1.503	−0.392	0.995	1.372	−1.784*	−1.504	−0.378	1.018	1.345
423	Salt Lake City	−1.728*	−1.399	0.015	1.493	1.866*	−1.498	−1.291	0.033	1.407	1.914*
397	Jacksonville (Florida)	−1.672*	−1.264	−0.063	1.443	2.010**	−1.631	−1.262	−0.031	1.501	2.036**
384	Hartford	−1.723*	−1.308	−0.006	1.481	1.900*	−1.586	−1.267	0.024	1.419	1.858*
355	Richmond VA	−1.631	−1.346	−0.039	1.448	1.645	−1.615	−1.330	0.070	1.493	1.740*
331	Louisville	−2.059**	−1.516	0.183	1.607	2.150**	−1.987**	−1.446	0.150	1.713*	2.171**
319	Westchester/So Connecticut	−2.825***	−1.891*	−0.111	1.595	2.539**	−2.670***	−1.966**	−0.171	1.627	2.155**
304	Birmingham	−1.496	−1.148	0.132	1.697*	2.331**	−1.295	−1.075	0.135	1.746*	2.078**
277	Memphis	−2.162**	−1.611	−0.025	1.826*	2.374**	−2.109**	−1.527	−0.122	1.412	1.968**
269	Oklahoma City	−1.135	−0.946	0.489	1.752*	2.117**	−1.156	−0.944	0.453	1.842*	2.168**
257	Providence	−2.288**	−1.646*	0.105	1.465	1.935*	−2.148**	−1.517	0.112	1.574	2.262**
242	New Orleans/Metairie/Kenner	−1.705*	−1.327	0.165	1.736*	2.208**	−1.594	−1.258	0.055	1.761*	2.156**
188	Buffalo/Niagara Falls	−3.192***	−1.789*	−0.156	2.598***	4.939***	−3.634***	−2.045**	−0.206	1.968**	4.400***
128	Marin/Sonoma	−1.805*	−1.396	0.000	1.744*	2.472**	−1.761*	−1.409	−0.147	1.681*	2.340**

Table 10: This table shows the distribution of T-statistics from 500 random draws of 5% of each market for Basic RHAT, or estimated rent without attribute adjustments. . Results are for adjustments based on the first matching criteria, and using comparable selection based on sum of squares from only significant coefficients with and without Green variables are shown. The results using hedonic adjustments from all coefficients, as opposed to only significant, are shown in Table 9. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

		Percentile for Sig. Coef.					Percentile for Sig. Coef. No Green				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
2606	Chicago	−1.427	−1.149	0.108	1.486	1.850*	−1.622	−1.322	0.085	1.346	1.582
2455	Washington DC	−1.700*	−1.363	−0.107	1.283	1.654*	−1.514	−1.214	−0.022	1.273	1.737*
2447	Los Angeles	−2.000**	−1.636	−0.254	0.961	1.289	−1.845*	−1.477	−0.227	0.998	1.260
1945	South Florida	−1.755*	−1.374	−0.123	1.122	1.590	−1.748*	−1.362	−0.132	1.141	1.508
1846	Dallas/Ft Worth	−1.420	−1.075	0.004	1.514	1.952*	−1.521	−1.184	0.050	1.604	1.928*
1742	Atlanta	−1.170	−0.989	0.319	1.905*	2.248**	−1.219	−0.980	0.242	1.882*	2.172**
1723	Northern New Jersey	−1.450	−1.162	0.257	1.450	1.775*	−1.513	−1.190	0.219	1.659*	2.003**
1661	Philadelphia	−1.603	−1.366	−0.222	1.273	1.824*	−1.502	−1.227	−0.214	1.251	1.605
1471	Phoenix	−1.467	−1.183	0.138	1.518	1.765*	−1.438	−1.076	0.154	1.499	1.862*
1415	Orange (California)	−1.445	−1.234	0.157	1.395	1.746*	−1.455	−1.142	0.017	1.384	1.652*
1386	Boston	−1.799*	−1.322	0.022	1.267	1.521	−1.874*	−1.443	−0.181	1.198	1.501
1323	Houston	−1.455	−1.184	0.190	1.437	1.760*	−1.290	−1.048	0.181	1.420	1.758*
1300	Detroit	−1.467	−1.187	0.003	1.589	1.999**	−1.406	−1.124	0.148	1.626	2.041**
1187	Seattle/Puget Sound	−1.411	−1.188	0.049	1.407	1.749*	−1.597	−1.292	0.020	1.388	1.842*
1177	Denver	−1.486	−1.265	−0.235	1.426	1.652*	−1.560	−1.306	−0.136	1.387	1.621
1009	Minneapolis/St Paul	−1.942*	−1.533	−0.124	1.148	1.385	−1.871*	−1.444	−0.072	1.225	1.541
983	San Diego	−1.504	−1.234	0.083	1.383	1.742*	−1.319	−1.039	0.251	1.548	1.921*
881	'St. Louis'	−1.417	−1.272	−0.074	1.420	1.750*	−1.452	−1.123	0.019	1.515	1.831*
876	Sacramento	−1.319	−1.145	−0.001	1.594	1.962**	−1.404	−1.095	0.109	1.531	1.889*
867	Long Island (New York)	−1.432	−1.186	0.040	1.490	1.873*	−1.539	−1.250	−0.048	1.488	1.871*
804	Kansas City	−1.327	−1.013	0.303	1.786*	2.188**	−1.262	−0.987	0.425	1.781*	2.205**
801	Inland Empire (California)	−1.389	−1.121	−0.036	1.460	1.780*	−1.465	−1.240	0.054	1.292	1.674*
785	Baltimore	−1.741*	−1.465	0.178	1.225	1.647*	−1.480	−1.130	0.142	1.240	1.608
777	New York City	−2.030**	−1.640	−0.080	1.063	1.284	−1.986**	−1.630	−0.084	1.070	1.314
769	Tampa/St Petersburg	−1.219	−0.910	0.444	1.905*	2.195**	−1.483	−1.173	0.167	1.565	1.889*
714	Portland	−1.256	−1.013	0.251	1.589	1.837*	−1.438	−1.098	0.315	1.613	1.935*
689	Columbus	−1.450	−1.242	0.061	1.340	1.730*	−1.622	−1.260	−0.096	1.314	1.832*
689	Las Vegas	−1.414	−1.155	0.215	1.434	1.889*	−1.403	−1.128	0.121	1.514	1.751*
676	East Bay/Oakland	−1.590	−1.317	−0.125	1.372	1.802*	−1.502	−1.264	−0.075	1.327	1.745*
652	Cleveland	−1.585	−1.247	0.245	1.404	1.705*	−1.661*	−1.229	0.134	1.380	1.700*
651	Charlotte	−1.335	−1.037	0.369	1.631	2.164**	−1.278	−1.064	0.416	1.798*	2.132**
642	Cincinnati/Dayton	−1.323	−0.975	0.550	1.844*	2.151**	−1.301	−1.088	0.424	1.717*	1.973**
620	Indianapolis	−1.863*	−1.475	0.052	1.283	1.587	−1.788*	−1.388	0.012	1.247	1.599
617	South Bay/San Jose	−1.646*	−1.365	0.080	1.496	1.898*	−1.569	−1.213	0.087	1.418	1.716*
		*Small sample issues possible below 600 N									
598	Orlando	−1.649*	−1.254	0.087	1.662*	2.220**	−1.687*	−1.413	−0.131	1.506	1.876*
569	Milwaukee/Madison	−1.374	−1.089	0.135	1.485	1.935*	−1.339	−1.110	0.194	1.443	1.840*

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		Percentile for Sig. Coef.					Percentile for Sig. Coef. No Green				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
567	Pittsburgh	−1.518	−1.119	0.413	1.406	1.838*	−1.643	−1.241	0.477	1.388	1.646*
560	Austin	−1.892*	−1.485	−0.202	1.146	1.582	−1.885*	−1.489	−0.098	1.135	1.397
538	San Francisco	−1.587	−1.267	0.077	1.507	1.737*	−1.568	−1.332	0.124	1.464	1.819*
519	Raleigh/Durham	−1.587	−1.368	−0.034	1.342	1.652*	−1.741*	−1.482	−0.122	1.276	1.626
448	Nashville	−1.756*	−1.379	0.067	1.572	2.060**	−1.590	−1.241	0.031	1.599	2.027**
444	San Antonio	−1.688*	−1.208	0.177	1.456	1.770*	−1.654*	−1.233	0.136	1.414	1.745*
430	Hampton Roads	−1.599	−1.316	−0.027	1.316	1.719*	−1.486	−1.197	0.113	1.359	1.640
423	Salt Lake City	−1.518	−1.155	0.237	1.515	1.803*	−1.560	−1.263	0.164	1.475	2.003**
397	Jacksonville (Florida)	−1.879*	−1.478	0.172	1.502	1.900*	−1.709*	−1.305	0.097	1.562	1.970**
384	Hartford	−1.993**	−1.480	−0.057	1.556	2.279**	−1.957*	−1.405	0.019	1.677*	2.237**
355	Richmond VA	−1.464	−1.121	0.171	1.522	1.875*	−1.640	−1.363	0.010	1.482	1.904*
331	Louisville	−2.715***	−1.664*	0.028	2.505**	4.267***	−2.429**	−1.810*	−0.008	1.926*	2.578***
319	Westchester/So Connecticut	−2.877***	−1.733*	0.141	2.050**	3.020***	−2.516**	−1.894*	0.089	1.975**	3.142***
304	Birmingham	−1.422	−1.139	0.287	2.009**	2.541**	−1.671*	−1.306	0.354	1.939*	2.535**
277	Memphis	−1.750*	−1.250	0.250	1.850*	3.106***	−2.314**	−1.575	−0.220	1.704*	3.096***
269	Oklahoma City	−1.233	−0.882	0.442	1.756*	2.112**	−1.357	−1.045	0.477	1.750*	2.096**
257	Providence	−2.583***	−1.858*	0.264	1.935*	2.905***	−2.375**	−1.724*	−0.015	1.909*	2.563**
242	New Orleans/Metairie/Kenner	−2.395**	−1.524	0.439	1.836*	2.975***	−1.974**	−1.404	−0.022	1.753*	2.975***
188	Buffalo/Niagara Falls	−19.035***	−3.480***	0.015	5.439***	5.439***	−4.194***	−0.963	0.053	68.433***	68.433***
128	Marin/Sonoma	−1.873*	−1.289	0.146	2.213**	3.755***	−1.823*	−1.353	0.168	2.115**	3.188***

Table 11: This table shows the distribution of T-statistics from 500 random draws of 5% of each market for Basic RHAT, or estimated rent without attribute adjustments. . Results are for adjustments based on the first matching criteria, and using comparable selection based on sum of squares from all coefficients with and without Green variables are shown. The results from using only significant coefficients for hedonic adjustment, as opposed to all coefficients, are shown in Table 8. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

		Percentile for All Coef. No Green					**Percentile for All Coef.**				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
2606	Chicago	−1.811*	−1.454	−0.266	1.037	1.398	−1.865*	−1.542	−0.337	0.927	1.232
2455	Washington DC	−1.786*	−1.549	−0.363	0.887	1.209	−1.718*	−1.441	−0.254	0.821	1.194
2447	Los Angeles	−2.100**	−1.709*	−0.318	0.842	1.177	−2.047**	−1.686*	−0.379	0.874	1.248
1945	South Florida	−1.877*	−1.546	−0.213	1.076	1.455	−1.776*	−1.302	−0.135	1.147	1.577
1846	Dallas/Ft Worth	−1.420	−1.234	−0.036	1.431	1.918*	−1.409	−1.102	0.036	1.389	1.694*
1742	Atlanta	−1.456	−1.192	−0.084	1.488	1.854*	−1.398	−1.080	0.006	1.613	1.938*
1723	Northern New Jersey	−1.430	−1.152	0.165	1.507	1.750*	−1.284	−1.041	0.283	1.633	1.952*
1661	Philadelphia	−1.461	−1.242	−0.128	1.187	1.635	−1.537	−1.338	−0.212	1.280	1.620
1471	Phoenix	−1.694*	−1.330	−0.201	1.200	1.654*	−1.562	−1.264	−0.179	1.300	1.733*
1415	Orange (California)	−1.667*	−1.360	−0.089	1.272	1.607	−1.703*	−1.422	−0.043	1.352	1.623
1386	Boston	−1.817*	−1.479	−0.132	1.216	1.585	−1.688*	−1.379	−0.051	1.181	1.470
1323	Houston	−1.411	−1.073	0.312	1.497	1.888*	−1.497	−1.114	0.189	1.426	2.003**
1300	Detroit	−1.362	−1.109	0.064	1.439	1.911*	−1.385	−1.065	0.030	1.424	1.772*
1187	Seattle/Puget Sound	−1.672*	−1.366	−0.206	1.222	1.608	−1.652*	−1.384	−0.131	1.315	1.719*
1177	Denver	−1.695*	−1.397	−0.261	1.095	1.568	−1.656*	−1.423	−0.384	1.218	1.592
1009	Minneapolis/St Paul	−1.856*	−1.496	−0.130	1.265	1.529	−1.811*	−1.555	−0.191	1.198	1.496
983	San Diego	−1.479	−1.073	0.191	1.520	1.967**	−1.447	−1.177	0.042	1.486	1.902*
881	'St. Louis'	−1.296	−1.088	0.196	1.519	1.754*	−1.377	−1.080	0.182	1.418	1.660*
876	Sacramento	−1.529	−1.301	−0.100	1.334	1.730*	−1.511	−1.321	−0.133	1.471	1.836*
867	Long Island (New York)	−1.398	−1.141	0.109	1.473	1.782*	−1.511	−1.286	−0.044	1.580	1.894*
804	Kansas City	−1.527	−1.177	0.128	1.562	1.958*	−1.348	−1.068	0.069	1.491	1.801*
801	Inland Empire (California)	−1.353	−1.083	0.135	1.495	1.767*	−1.305	−1.041	0.232	1.544	1.818*
785	Baltimore	−1.821*	−1.406	0.071	1.167	1.530	−1.734*	−1.402	0.102	1.249	1.511
777	New York City	−1.916*	−1.615	−0.142	1.128	1.377	−1.969**	−1.582	0.043	1.113	1.332
769	Tampa/St Petersburg	−1.313	−1.025	0.230	1.613	2.071**	−1.225	−1.041	0.166	1.629	1.949*
714	Portland	−1.388	−1.092	0.065	1.576	1.879*	−1.269	−1.031	0.268	1.518	1.768*
689	Columbus	−1.632	−1.269	−0.115	1.251	1.572	−1.756*	−1.411	−0.082	1.466	1.718*
689	Las Vegas	−1.507	−1.208	0.115	1.723*	2.061**	−1.465	−1.158	0.014	1.509	2.127**
676	East Bay/Oakland	−1.689*	−1.315	−0.097	1.410	1.891*	−1.583	−1.275	−0.000	1.528	1.757*
652	Cleveland	−1.722*	−1.328	0.114	1.317	1.651*	−1.761*	−1.286	0.259	1.381	1.666*
651	Charlotte	−1.290	−1.002	0.303	1.601	2.039**	−1.333	−1.111	0.360	1.673*	1.946*
642	Cincinnati/Dayton	−1.337	−1.036	0.502	1.823*	2.252**	−1.403	−1.119	0.378	1.715*	2.112**
620	Indianapolis	−2.022**	−1.487	0.009	1.208	1.528	−1.903*	−1.623	−0.049	1.171	1.491
617	South Bay/San Jose	−1.569	−1.244	0.124	1.577	1.979**	−1.500	−1.197	0.073	1.490	1.831*
		*Small sample issues possible below 600 N									
598	Orlando	−1.627	−1.301	0.031	1.494	1.871*	−1.569	−1.328	−0.026	1.466	1.854*

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marketn	marketname	Percentile for All Coef. No Green 5th	10th	Median	90th	95th	Percentile for All Coef. 5th	10th	Median	90th	95th
569	Milwaukee/Madison	−1.403	−1.107	0.238	1.536	1.921*	−1.494	−1.159	0.137	1.466	1.808*
567	Pittsburgh	−1.551	−1.186	0.370	1.500	1.914*	−1.593	−1.125	0.495	1.585	1.981**
560	Austin	−1.931*	−1.556	−0.210	1.285	1.575	−1.799*	−1.452	−0.118	1.242	1.513
538	San Francisco	−1.472	−1.220	0.161	1.567	1.876*	−1.604	−1.353	0.081	1.459	1.716*
519	Raleigh/Durham	−1.751*	−1.469	−0.013	1.290	1.584	−1.693*	−1.360	−0.155	1.300	1.586
448	Nashville	−1.696*	−1.330	0.028	1.408	1.811*	−1.649*	−1.326	−0.004	1.478	1.975**
444	San Antonio	−1.844*	−1.376	0.179	1.384	1.774*	−1.622	−1.290	0.199	1.451	1.724*
430	Hampton Roads	−1.906*	−1.408	−0.203	1.167	1.488	−1.694*	−1.334	0.005	1.280	1.675*
423	Salt Lake City	−1.455	−1.251	0.208	1.440	1.765*	−1.536	−1.175	0.187	1.437	1.925*
397	Jacksonville (Florida)	−2.002**	−1.479	0.127	1.625	1.941*	−1.907*	−1.452	0.148	1.553	2.001**
384	Hartford	−1.971**	−1.366	0.187	1.754*	2.581***	−1.723*	−1.408	0.043	1.748*	2.490**
355	Richmond VA	−1.497	−1.229	0.039	1.455	1.853*	−1.530	−1.322	0.018	1.474	1.977**
331	Louisville	−2.893***	−1.766*	0.188	2.380**	3.552***	−2.218**	−1.291	0.066	1.787*	3.184***
319	Westchester/So Connecticut	−2.394**	−1.694*	−0.018	2.032**	4.541***	−3.087***	−2.059**	0.035	2.004**	2.680***
304	Birmingham	−1.408	−1.026	0.495	2.013**	2.685***	−1.445	−0.973	0.489	1.908*	2.357**
277	Memphis	−2.269**	−1.618	−0.015	2.083**	3.259***	−2.008**	−1.549	−0.021	1.864*	2.870***
269	Oklahoma City	−1.464	−1.002	0.609	1.873*	2.293**	−1.242	−1.047	0.413	1.792*	2.236**
257	Providence	−2.694***	−1.651*	0.178	1.834*	2.754***	−2.001**	−1.434	0.326	1.948*	2.563**
242	New Orleans/Metairie/Kenner	−1.993**	−1.416	0.116	1.953*	2.784***	−1.966**	−1.405	0.214	1.705*	2.460**
188	Buffalo/Niagara Falls	−19.035***	−4.194***	0.053	68.433***	68.433***	−4.194***	−1.383	−0.203	4.148***	5.052***
128	Marin/Sonoma	−2.072**	−1.541	−0.099	2.174**	3.244***	−1.774*	−1.283	0.057	2.065**	2.987***

Table 12: This table shows the distribution of T-statistics from 500 random draws of 5% of each market for Hedonic RHAT, estimated rent using hedonic adjustments based on building attributes. Results are for adjustments based on the first, and less stringent matching criteria if necessary, and using results for adjustments based on only significant coefficients with and without Green variables are shown. The results using hedonic adjustments from all coefficients, as opposed to only significant, are shown in Table 13. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

		Percentile for Sig. Coef.					Percentile for Sig. Coef. No Green				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
2606	Chicago	−1.474	−1.195	0.039	1.352	1.666*	−1.555	−1.218	0.076	1.484	1.830*
2455	Washington DC	−1.475	−1.153	−0.126	1.270	1.645*	−1.491	−1.185	−0.017	1.364	1.642
2447	Los Angeles	−1.526	−1.096	0.239	1.470	1.842*	−1.259	−0.946	0.206	1.477	1.965**
1945	South Florida	−1.448	−0.981	0.271	1.672*	2.103**	−1.283	−0.937	0.283	1.626	1.890*
1846	Dallas/Ft Worth	−1.654*	−1.429	−0.360	1.080	1.507	−1.546	−1.383	−0.282	1.086	1.429
1742	Atlanta	−1.211	−0.947	0.488	2.012**	2.417**	−1.141	−0.922	0.420	1.935*	2.232**
1723	Northern New Jersey	−1.563	−1.266	−0.044	1.264	1.672*	−1.482	−1.077	0.070	1.421	1.849*
1661	Philadelphia	−1.739*	−1.453	−0.386	0.908	1.394	−1.681*	−1.449	−0.304	1.114	1.638
1471	Phoenix	−1.553	−1.318	−0.132	1.410	1.770*	−1.490	−1.252	−0.100	1.293	1.666*
1415	Orange (California)	−1.120	−0.741	0.594	1.848*	2.194**	−1.295	−0.883	0.572	1.807*	2.155**
1386	Boston	−1.603	−1.314	−0.026	1.422	1.742*	−1.615	−1.383	−0.045	1.229	1.489
1323	Houston	−1.646*	−1.376	−0.221	0.960	1.377	−1.716*	−1.420	−0.080	1.166	1.509
1300	Detroit	−1.447	−1.098	0.029	1.558	1.987**	−1.433	−1.163	0.075	1.791*	2.170**
1187	Seattle/Puget Sound	−1.776*	−1.521	−0.188	1.281	1.579	−1.640	−1.389	−0.233	1.118	1.515
1177	Denver	−1.417	−1.167	−0.012	1.316	1.638	−1.493	−1.220	0.026	1.472	1.843*
1009	Minneapolis/St Paul	−1.672*	−1.349	0.167	1.311	1.707*	−1.521	−1.195	0.066	1.335	1.613
983	San Diego	−0.979	−0.657	0.615	2.137**	2.515**	−0.856	−0.571	0.691	2.095**	2.372**
881	'St. Louis'	−1.409	−1.179	0.031	1.406	1.739*	−1.406	−1.188	0.036	1.451	1.713*
876	Sacramento	−0.905	−0.633	0.689	2.311**	2.640***	−0.924	−0.638	0.683	2.180**	2.524**
867	Long Island (New York)	−1.900*	−1.511	−0.150	1.135	1.385	−1.893*	−1.659*	−0.194	1.098	1.419
804	Kansas City	−1.102	−0.840	0.472	1.882*	2.298**	−1.157	−0.952	0.207	1.902*	2.296**
801	Inland Empire (California)	−1.521	−1.352	−0.234	1.412	1.758*	−1.585	−1.215	−0.125	1.339	1.760*
785	Baltimore	−1.469	−1.144	0.079	1.323	1.794*	−1.333	−1.040	0.141	1.462	1.845*
777	New York City	−1.737*	−1.193	0.416	1.398	1.595	−1.804*	−1.268	0.406	1.382	1.579
769	Tampa/St Petersburg	−1.058	−0.735	0.575	2.063**	2.521**	−1.063	−0.753	0.617	2.019**	2.369**
714	Portland	−1.384	−1.143	0.210	1.681*	1.932*	−1.380	−1.149	0.084	1.491	1.851*
689	Columbus	−1.607	−1.338	−0.210	1.196	1.534	−1.643	−1.335	0.101	1.333	1.684*
689	Las Vegas	−1.749*	−1.421	−0.110	1.277	1.654*	−1.604	−1.261	−0.013	1.364	1.702*
676	East Bay/Oakland	−1.482	−1.158	0.161	1.673*	1.912*	−1.401	−1.107	0.133	1.505	1.917*
652	Cleveland	−1.607	−1.229	0.200	1.438	1.710*	−1.592	−1.296	0.117	1.362	1.606
651	Charlotte	−1.313	−1.008	0.266	1.591	1.935*	−1.446	−0.981	0.356	1.670*	2.002**
642	Cincinnati/Dayton	−1.347	−1.047	0.124	1.647*	1.947*	−1.357	−1.083	0.185	1.709*	2.077**
620	Indianapolis	−1.483	−1.100	0.293	1.378	1.779*	−1.544	−1.196	0.175	1.372	1.614
617	South Bay/San Jose	−1.627	−1.335	−0.115	1.288	1.715*	−1.607	−1.311	−0.004	1.256	1.706*
		*Small sample issues possible below 600 N									
598	Orlando	−1.475	−1.145	−0.246	1.744*	2.243**	−1.317	−0.992	0.343	1.911*	2.368**

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		Percentile for Sig. Coef.					Percentile for Sig. Coef. No Green				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
569	Milwaukee/Madison	−1.708*	−1.368	−0.100	1.238	1.607	−1.661*	−1.406	−0.114	1.212	1.534
567	Pittsburgh	−1.571	−1.333	0.035	1.372	1.649*	−1.838*	−1.443	−0.015	1.400	1.773*
560	Austin	−2.031**	−1.547	−0.169	1.187	1.454	−1.832*	−1.529	−0.045	1.205	1.542
538	San Francisco	−1.251	−0.870	0.344	1.720*	2.039**	−1.548	−1.196	0.145	1.570	1.974**
519	Raleigh/Durham	−1.597	−1.330	−0.102	1.290	1.685*	−1.554	−1.231	−0.106	1.195	1.604
448	Nashville	−1.562	−1.202	−0.123	1.456	1.826*	−1.746*	−1.441	−0.195	1.381	1.793*
444	San Antonio	−1.327	−1.067	0.242	1.557	1.851*	−1.428	−1.019	0.349	1.613	1.952*
430	Hampton Roads	−1.405	−1.062	0.034	1.457	1.961**	−1.478	−1.243	0.148	1.718*	2.099**
423	Salt Lake City	−1.403	−1.081	0.125	1.492	1.804*	−1.520	−1.215	0.158	1.542	1.937*
397	Jacksonville (Florida)	−1.474	−1.209	0.250	1.707*	2.201**	−1.435	−1.179	0.064	1.703*	2.207**
384	Hartford	−1.717*	−1.418	−0.215	1.148	1.754*	−1.786*	−1.501	−0.197	1.248	1.693*
355	Richmond VA	−1.622	−1.255	−0.070	1.573	1.917*	−1.530	−1.310	0.048	1.385	1.719*
331	Louisville	−1.792*	−1.040	0.455	1.919*	2.662***	−1.767*	−1.275	0.271	1.718*	2.201**
319	Westchester/So Connecticut	−3.228***	−2.191**	−0.026	1.357	1.981**	−2.412**	−1.997**	−0.127	1.488	1.999**
304	Birmingham	−1.610	−1.439	−0.155	1.583	2.072**	−1.844*	−1.328	−0.010	1.465	1.861*
277	Memphis	−1.614	−1.207	0.062	1.912*	2.406**	−1.647*	−1.253	0.120	1.847*	2.513**
269	Oklahoma City	−1.044	−0.809	0.632	1.973**	2.496**	−1.176	−0.960	0.542	1.827*	2.266**
257	Providence	−1.619	−1.002	0.272	1.814*	2.494**	−1.538	−1.178	0.178	1.891*	2.495**
242	New Orleans/Metairie/Kenner	−1.612	−1.215	0.289	1.895*	2.434**	−1.780*	−1.237	0.299	1.868*	2.316**
188	Buffalo/Niagara Falls	−2.066**	−1.351	0.014	2.342**	3.797***	−1.940*	−1.218	0.384	3.569***	6.407***
128	Marin/Sonoma	−1.773*	−1.483	−0.085	1.796*	2.669***	−1.950*	−1.505	−0.093	1.819*	2.473**

Table 13: This table shows the distribution of T-statistics from 500 random draws of 5% of each market for Hedonic RHAT, estimated rent using hedonic adjustments based on building attributes.. Results are for adjustments based on the first, and less stringent matching criteria if necessary, and using all coefficients with and without Green variables are shown. The results from using only significant coefficients for hedonic adjustment, as opposed to all coefficients, are shown in Table 12. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

		Percentile for All Coef. No Green					Percentile for All Coef.				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
2606	Chicago	−1.167	−0.885	0.353	1.664*	1.977**	−1.279	−0.831	0.455	1.618	1.995**
2455	Washington DC	−1.894*	−1.529	−0.403	0.959	1.299	−1.881*	−1.512	−0.225	1.060	1.308
2447	Los Angeles	−1.462	−1.051	0.186	1.547	1.828*	−1.205	−0.865	0.380	1.581	1.891*
1945	South Florida	−1.777*	−1.412	−0.191	1.037	1.401	−1.742*	−1.459	−0.074	1.202	1.562
1846	Dallas/Ft Worth	−1.080	−0.767	0.492	1.798*	2.090**	−0.878	−0.663	0.552	1.928*	2.421**
1742	Atlanta	−1.290	−0.970	0.157	1.781*	2.263**	−1.208	−1.022	0.228	1.672*	2.125**
1723	Northern New Jersey	−1.132	−0.872	0.360	1.733*	2.106**	−1.227	−0.905	0.343	1.541	1.904*
1661	Philadelphia	−1.200	−0.823	0.454	1.831*	2.292**	−1.079	−0.846	0.501	1.891*	2.220**
1471	Phoenix	−0.977	−0.681	0.572	1.852*	2.354**	−1.076	−0.622	0.761	2.101**	2.453**
1415	Orange (California)	−1.008	−0.790	0.613	1.906*	2.263**	−1.084	−0.704	0.620	1.786*	2.184**
1386	Boston	−1.676*	−1.398	−0.034	1.159	1.434	−1.816*	−1.521	−0.058	1.197	1.573
1323	Houston	−1.413	−1.173	0.169	1.526	1.805*	−1.336	−1.001	0.170	1.569	1.974**
1300	Detroit	−1.108	−0.773	0.355	1.676*	2.080**	−1.281	−0.934	0.362	1.731*	2.177**
1187	Seattle/Puget Sound	−1.471	−1.152	0.097	1.449	1.939*	−1.378	−1.067	0.210	1.362	1.710*
1177	Denver	−1.353	−1.020	0.276	1.476	1.913*	−1.337	−1.015	0.216	1.593	2.003**
1009	Minneapolis/St Paul	−1.665*	−1.347	−0.118	1.258	1.586	−1.816*	−1.259	0.050	1.320	1.698*
983	San Diego	−1.531	−1.170	0.254	1.454	1.764*	−1.385	−1.112	0.125	1.388	1.820*
881	'St. Louis'	−1.324	−1.033	0.335	1.651*	2.158**	−1.443	−1.009	0.354	1.595	1.927*
876	Sacramento	−1.318	−1.037	0.320	1.671*	2.022**	−1.248	−1.008	0.384	1.663*	1.950*
867	Long Island (New York)	−1.512	−1.099	0.186	1.600	1.866*	−1.630	−1.232	0.082	1.402	1.793*
804	Kansas City	−1.001	−0.772	0.591	1.935*	2.223**	−1.066	−0.692	0.648	1.905*	2.302**
801	Inland Empire (California)	−1.199	−0.885	0.580	1.832*	2.155**	−1.186	−0.866	0.478	1.876*	2.162**
785	Baltimore	−1.583	−1.128	0.132	1.423	1.850*	−1.641	−1.194	0.177	1.382	1.688*
777	New York City	−1.809*	−1.576	−0.201	1.104	1.339	−1.960*	−1.467	0.004	1.148	1.339
769	Tampa/St Petersburg	−1.647*	−1.299	−0.046	1.284	1.736*	−1.563	−1.341	−0.005	1.243	1.612
714	Portland	−1.751*	−1.334	0.086	1.541	1.973**	−1.686*	−1.269	−0.053	1.336	1.821*
689	Columbus	−1.880*	−1.509	−0.211	1.072	1.562	−1.743*	−1.431	−0.187	1.029	1.412
689	Las Vegas	−1.349	−1.023	0.170	1.525	1.906*	−1.379	−1.070	0.200	1.447	1.850*
676	East Bay/Oakland	−1.460	−1.084	0.131	1.391	1.663*	−1.519	−1.084	0.252	1.630	1.944*
652	Cleveland	−1.472	−1.198	0.068	1.408	1.673*	−1.532	−1.134	0.173	1.558	2.079**
651	Charlotte	−1.336	−1.000	0.173	1.642	2.017**	−1.355	−0.987	0.282	1.693*	2.192**
642	Cincinnati/Dayton	−1.463	−1.177	−0.061	1.230	1.555	−1.645	−1.346	−0.007	1.430	1.895*
620	Indianapolis	−1.127	−0.723	0.571	1.783*	2.166**	−1.321	−0.870	0.617	1.686*	2.059**
617	South Bay/San Jose	−1.256	−0.815	0.324	1.681*	1.973**	−1.183	−0.851	0.486	1.855*	2.331**
		*Small sample issues possible below 600 N									
598	Orlando	−2.117**	−1.626	−0.222	1.290	1.675*	−1.877*	−1.542	−0.150	1.392	1.696*

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		Percentile for All Coef. No Green					Percentile for All Coef.				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
569	Milwaukee/Madison	−1.419	−1.089	0.295	1.454	2.057**	−1.334	−0.898	0.315	1.693*	2.054**
567	Pittsburgh	−1.476	−1.093	0.245	1.625	1.952*	−1.544	−1.075	0.120	1.470	1.811*
560	Austin	−1.531	−1.256	0.037	1.511	1.760*	−1.645	−1.352	0.041	1.576	2.053**
538	San Francisco	−1.498	−1.222	0.063	1.333	1.747*	−1.546	−1.204	−0.074	1.427	1.888*
519	Raleigh/Durham	−1.450	−1.103	0.262	1.587	1.954*	−1.479	−1.090	0.232	1.530	1.954*
448	Nashville	−1.742*	−1.254	0.055	1.396	1.771*	−1.805*	−1.256	0.088	1.366	1.743*
444	San Antonio	−1.666*	−1.274	0.205	1.476	1.895*	−1.362	−1.003	0.347	1.722*	1.992**
430	Hampton Roads	−1.285	−0.848	0.286	1.748*	2.060**	−1.207	−0.813	0.365	1.723*	2.154**
423	Salt Lake City	−1.442	−1.140	0.300	1.817*	2.184**	−1.465	−1.038	0.370	1.682*	2.097**
397	Jacksonville (Florida)	−1.962**	−1.335	0.109	1.465	1.836*	−1.826*	−1.390	0.150	1.490	1.823*
384	Hartford	−2.202**	−1.552	0.018	1.279	1.605	−1.977**	−1.434	−0.054	1.273	1.618
355	Richmond VA	−1.488	−1.033	0.285	1.546	2.058**	−1.416	−1.057	0.278	1.713*	2.174**
331	Louisville	−2.219**	−1.541	0.088	1.555	2.043**	−2.110**	−1.349	0.052	1.691*	2.208**
319	Westchester/So Connecticut	−2.131**	−1.556	−0.081	1.416	1.826*	−2.521**	−1.773*	−0.087	1.576	2.226**
304	Birmingham	−1.920*	−1.469	−0.096	1.274	1.783*	−1.755*	−1.419	−0.096	1.266	1.730*
277	Memphis	−2.542**	−1.772*	−0.137	1.644	2.407**	−2.267**	−1.614	−0.184	1.276	1.952*
269	Oklahoma City	−1.451	−1.116	0.220	1.708*	2.094**	−1.355	−1.099	0.145	1.549	2.052**
257	Providence	−1.831*	−1.217	0.166	1.862*	2.763***	−1.513	−1.104	0.229	1.883*	2.507**
242	New Orleans/Metairie/Kenner	−1.957*	−1.493	−0.019	1.528	2.259**	−2.129**	−1.607	0.090	1.678*	2.349**
188	Buffalo/Niagara Falls	−5.031***	−2.809***	0.012	1.962**	3.314***	−2.840***	−1.883*	0.059	3.891***	7.701***
128	Marin/Sonoma	−2.499**	−1.832*	−0.091	1.418	2.193**	−2.308**	−1.684*	−0.052	1.614	2.537**

Table 14: This table shows the distribution of T-statistics from 500 random draws of 5% of each market for Hedonic RHAT, estimated rent using hedonic adjustments based on building attributes.. Results are for adjustments based on the first matching criteria, and using only significant coefficients with and without Green variables are shown. The results using hedonic adjustments from all coefficients, as opposed to only significant, are shown in Table 13. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

		Percentile for Sig. Coef.					Percentile for Sig. Coef. No Green				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
2606	Chicago	−1.371	−1.082	0.197	1.416	1.661*	−1.505	−1.136	0.103	1.437	1.769*
2455	Washington DC	−1.446	−1.133	0.035	1.440	1.868*	−1.380	−1.162	0.008	1.360	1.801*
2447	Los Angeles	−1.581	−1.218	0.163	1.359	1.802*	−1.455	−1.053	0.197	1.419	1.720*
1945	South Florida	−1.557	−1.218	0.098	1.379	1.777*	−1.553	−1.174	−0.015	1.265	1.678*
1846	Dallas/Ft Worth	−1.505	−1.272	−0.242	1.210	1.600	−1.724*	−1.345	−0.092	1.309	1.701*
1742	Atlanta	−1.050	−0.846	0.440	2.106**	2.476**	−1.105	−0.856	0.542	2.168**	2.690***
1723	Northern New Jersey	−1.604	−1.248	0.108	1.472	1.803*	−1.549	−1.206	0.110	1.513	1.924*
1661	Philadelphia	−1.815*	−1.463	−0.403	1.066	1.448	−1.673*	−1.295	−0.351	1.049	1.560
1471	Phoenix	−1.390	−1.091	0.309	1.592	2.009**	−1.282	−0.979	0.260	1.566	1.987**
1415	Orange (California)	−1.251	−0.791	0.465	1.670*	2.065**	−1.166	−0.938	0.306	1.660*	2.070**
1386	Boston	−1.614	−1.311	0.018	1.271	1.653*	−1.743*	−1.389	−0.080	1.272	1.569
1323	Houston	−1.684*	−1.445	−0.186	1.156	1.504	−1.501	−1.235	−0.092	1.228	1.650*
1300	Detroit	−1.492	−1.234	−0.024	1.580	2.014**	−1.419	−1.136	0.176	1.685*	2.095**
1187	Seattle/Puget Sound	−1.653*	−1.386	−0.198	1.126	1.561	−1.754*	−1.450	−0.115	1.253	1.726*
1177	Denver	−1.619	−1.340	−0.179	1.235	1.612	−1.662*	−1.415	−0.092	1.429	1.816*
1009	Minneapolis/St Paul	−1.955*	−1.440	−0.101	1.135	1.442	−1.699*	−1.385	−0.024	1.306	1.566
983	San Diego	−1.099	−0.787	0.501	1.824*	2.176**	−0.902	−0.597	0.724	1.971**	2.389**
881	'St. Louis'	−1.330	−1.032	0.188	1.593	1.878*	−1.263	−1.035	0.256	1.620	1.997**
876	Sacramento	−1.059	−0.819	0.482	2.161**	2.443**	−1.061	−0.803	0.490	1.977**	2.310**
867	Long Island (New York)	−1.758*	−1.524	−0.319	1.210	1.622	−1.784*	−1.499	−0.299	1.119	1.470
804	Kansas City	−1.126	−0.817	0.631	2.068**	2.449**	−1.175	−0.802	0.798	2.064**	2.428**
801	Inland Empire (California)	−1.351	−1.188	−0.057	1.380	1.686*	−1.602	−1.319	−0.162	1.161	1.447
785	Baltimore	−1.601	−1.102	0.225	1.488	1.811*	−1.312	−0.930	0.242	1.423	1.737*
777	New York City	−1.928*	−1.486	0.149	1.130	1.364	−1.748*	−1.383	0.017	1.178	1.347
769	Tampa/St Petersburg	−1.193	−0.874	0.538	2.071**	2.539**	−1.252	−0.970	0.377	1.901*	2.268**
714	Portland	−1.211	−0.941	0.378	1.714*	2.059**	−1.362	−1.096	0.485	1.722*	2.035**
689	Columbus	−1.518	−1.218	0.108	1.372	1.730*	−1.429	−1.171	0.022	1.443	1.928*
689	Las Vegas	−1.498	−1.256	0.093	1.398	1.954*	−1.400	−1.143	0.129	1.545	1.872*
676	East Bay/Oakland	−1.594	−1.375	−0.193	1.306	1.728*	−1.397	−1.200	−0.057	1.445	1.886*
652	Cleveland	−1.659*	−1.326	0.161	1.273	1.611	−1.737*	−1.465	0.058	1.303	1.694*
651	Charlotte	−1.380	−1.098	0.191	1.635	1.871*	−1.357	−1.048	0.408	1.794*	2.200**
642	Cincinnati/Dayton	−1.396	−1.020	0.351	1.792*	2.214**	−1.430	−1.151	0.337	1.698*	2.094**
620	Indianapolis	−1.762*	−1.090	0.241	1.481	1.688*	−1.772*	−1.327	0.100	1.386	1.689*
617	South Bay/San Jose	−1.630	−1.309	−0.084	1.503	1.932*	−1.516	−1.194	−0.052	1.496	1.986**
	*Small sample issues possible below 600 N										
598	Orlando	−1.390	−1.103	0.304	1.906*	2.546**	−1.526	−1.144	0.194	1.795*	2.265**
569	Milwaukee/Madison	−1.557	−1.271	−0.063	1.324	1.740*	−1.651*	−1.329	−0.048	1.256	1.595

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marketn	marketname	Percentile for Sig. Coef. 5th	10th	Median	90th	95th	Percentile for Sig. Coef. No Green 5th	10th	Median	90th	95th
567	Pittsburgh	−1.716*	−1.249	0.107	1.367	1.908*	−1.924*	−1.317	0.224	1.310	1.612
560	Austin	−1.896*	−1.538	−0.156	1.182	1.540	−1.814*	−1.463	−0.103	1.105	1.475
538	San Francisco	−1.570	−1.128	0.232	1.626	2.024**	−1.613	−1.167	0.110	1.443	1.849*
519	Raleigh/Durham	−1.841*	−1.516	−0.142	1.184	1.488	−2.051**	−1.668*	−0.237	1.145	1.530
448	Nashville	−1.770*	−1.421	0.033	1.505	1.943*	−1.713*	−1.374	0.093	1.508	1.984**
444	San Antonio	−1.380	−0.980	0.335	1.645	2.228**	−1.397	−1.064	0.300	1.696*	2.038**
430	Hampton Roads	−1.362	−1.059	0.165	1.430	1.972**	−1.222	−0.980	0.394	1.858*	2.110**
423	Salt Lake City	−1.456	−1.113	0.134	1.584	1.984**	−1.464	−1.151	0.162	1.745*	2.157**
397	Jacksonville (Florida)	−2.197**	−1.364	0.207	1.770*	2.502**	−1.713*	−1.127	0.262	1.773*	2.559**
384	Hartford	−1.974**	−1.399	−0.063	1.444	2.128**	−2.225**	−1.549	0.066	1.692*	2.627***
355	Richmond VA	−1.398	−1.043	0.226	1.657*	1.903*	−1.602	−1.279	0.080	1.664*	2.106**
331	Louisville	−2.233**	−1.471	0.165	2.367**	3.212***	−2.056**	−1.442	0.229	2.186**	4.239***
319	Westchester/So Connecticut	−6.453***	−3.225***	0.021	1.796*	3.332***	−4.329***	−2.883***	0.167	1.529	2.840***
304	Birmingham	−1.544	−1.147	0.188	1.908*	2.475**	−1.782*	−1.228	0.183	1.700*	2.362**
277	Memphis	−1.896*	−1.307	0.136	1.902*	2.844***	−2.222**	−1.512	−0.042	1.883*	2.792***
269	Oklahoma City	−1.313	−0.974	0.412	1.643	2.080**	−1.493	−1.009	0.409	1.637	1.968**
257	Providence	−2.825***	−1.802*	0.291	2.642***	5.374***	−2.802***	−1.693*	0.247	2.443**	4.491***
242	New Orleans/Metairie/Kenner	−1.517	−1.282	0.461	1.838*	3.655***	−2.122**	−1.541	0.011	1.740*	2.558**
188	Buffalo/Niagara Falls	−1.749*	−1.749*	0.817	2.790***	6.168***	−2.750***	−1.287	0.817	2.495**	8.811***
128	Marin/Sonoma	−2.868***	−1.874*	0.017	1.905*	2.928***	−2.680***	−1.692*	0.067	1.618	2.580***

Table 15: This table shows the distribution of T-statistics from 500 random draws of 5% of each market for Hedonic RHAT, estimated rent using hedonic adjustments based on building attributes.. Results are for adjustments based on the first matching criteria, and using all coefficients with and without Green variables are shown. The results from using only significant coefficients for hedonic adjustment, as opposed to all coefficients, are shown in Table 12. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

		Percentile for All Coef. No Green					Percentile for All Coef.				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
2606	Chicago	−1.338	−1.023	0.230	1.607	1.939*	−1.272	−0.986	0.363	1.562	1.864*
2455	Washington DC	−2.253**	−1.732*	−0.500	0.759	1.236	−1.744*	−1.409	−0.196	1.036	1.502
2447	Los Angeles	−1.620	−1.263	0.029	1.206	1.615	−1.673*	−1.249	−0.046	1.241	1.556
1945	South Florida	−1.737*	−1.400	−0.117	1.053	1.455	−1.675*	−1.355	−0.132	1.221	1.526
1846	Dallas/Ft Worth	−1.441	−1.181	0.187	1.624	1.940*	−1.262	−0.862	0.287	1.720*	2.189**
1742	Atlanta	−1.267	−0.984	0.225	1.790*	2.156**	−1.220	−0.936	0.292	1.710*	2.077**
1723	Northern New Jersey	−1.435	−1.043	0.370	1.695*	2.054**	−1.243	−0.870	0.453	1.651*	1.902*
1661	Philadelphia	−1.150	−0.891	0.469	1.632	1.998**	−1.272	−0.902	0.451	1.725*	2.124**
1471	Phoenix	−1.368	−0.913	0.303	1.643	1.978**	−1.340	−0.915	0.435	1.720*	2.090**
1415	Orange (California)	−1.263	−0.921	0.352	1.662*	2.015**	−1.334	−0.932	0.390	1.816*	2.179**
1386	Boston	−1.735*	−1.356	−0.058	1.246	1.603	−1.687*	−1.357	−0.051	1.130	1.419
1323	Houston	−1.398	−1.101	0.123	1.472	1.873*	−1.591	−1.235	0.118	1.543	1.888*
1300	Detroit	−1.306	−1.016	0.170	1.546	2.026**	−1.548	−1.155	0.100	1.490	1.822*
1187	Seattle/Puget Sound	−1.590	−1.245	0.025	1.285	1.606	−1.543	−1.120	0.086	1.457	1.894*
1177	Denver	−1.559	−1.231	−0.039	1.209	1.772*	−1.574	−1.247	−0.053	1.349	1.892*
1009	Minneapolis/St Paul	−1.771*	−1.442	−0.058	1.269	1.710*	−1.675*	−1.296	−0.024	1.304	1.749*
983	San Diego	−1.636	−1.247	0.145	1.468	1.874*	−1.478	−1.129	0.103	1.351	1.822*
881	’St. Louis’	−1.446	−1.063	0.283	1.622	1.896*	−1.451	−1.124	0.350	1.678*	1.894*
876	Sacramento	−1.554	−1.176	0.106	1.447	1.859*	−1.509	−1.089	0.198	1.638	1.935*
867	Long Island (New York)	−1.676*	−1.330	−0.106	1.140	1.591	−1.613	−1.345	−0.186	1.030	1.402
804	Kansas City	−1.173	−0.774	0.431	1.734*	2.126**	−1.291	−0.933	0.338	1.551	1.908*
801	Inland Empire (California)	−1.166	−0.981	0.415	1.895*	2.281**	−1.228	−0.833	0.341	1.774*	2.201**
785	Baltimore	−1.741*	−1.271	0.047	1.331	1.652*	−1.455	−1.088	0.157	1.501	1.810*
777	New York City	−2.011**	−1.707*	−0.236	1.026	1.290	−1.999**	−1.599	0.013	1.106	1.346
769	Tampa/St Petersburg	−1.658*	−1.143	0.165	1.359	1.684*	−1.368	−1.101	−0.027	1.510	1.844*
714	Portland	−1.606	−1.283	−0.074	1.256	1.744*	−1.700*	−1.242	−0.022	1.396	1.923*
689	Columbus	−1.605	−1.242	−0.055	1.266	1.738*	−1.739*	−1.339	−0.010	1.412	1.816*
689	Las Vegas	−1.732*	−1.065	0.120	1.565	1.803*	−1.558	−1.225	0.089	1.523	2.111**
676	East Bay/Oakland	−1.776*	−1.316	0.100	1.462	2.017**	−1.562	−1.156	0.176	1.598	2.172**
652	Cleveland	−1.704*	−1.357	0.065	1.374	1.693*	−1.893*	−1.444	0.147	1.425	1.683*
651	Charlotte	−1.303	−1.051	0.275	1.613	2.052**	−1.400	−0.940	0.369	1.811*	2.149**
642	Cincinnati/Dayton	−1.222	−0.942	0.357	1.859*	2.216**	−1.351	−0.903	0.441	1.893*	2.339**
620	Indianapolis	−1.647*	−1.266	0.128	1.421	1.756*	−1.477	−1.155	0.016	1.537	1.881*
617	South Bay/San Jose	−1.737*	−1.325	0.024	1.459	1.894*	−1.464	−1.162	0.106	1.445	1.833*
		*Small sample issues possible below 600 N									
598	Orlando	−1.995**	−1.444	0.038	1.284	1.676*	−2.016**	−1.387	−0.076	1.409	1.845*

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		Percentile for All Coef. No Green					Percentile for All Coef.				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
569	Milwaukee/Madison	−1.815*	−1.393	−0.030	1.386	2.021**	−1.813*	−1.394	−0.155	1.198	1.618
567	Pittsburgh	−1.823*	−1.394	0.086	1.536	1.843*	−1.703*	−1.291	0.090	1.545	1.985**
560	Austin	−1.627	−1.172	0.100	1.514	1.997**	−1.623	−1.300	0.011	1.507	1.833*
538	San Francisco	−1.446	−1.216	0.031	1.356	1.814*	−1.863*	−1.409	−0.097	1.333	1.763*
519	Raleigh/Durham	−1.806*	−1.387	−0.027	1.237	1.630	−1.901*	−1.218	0.082	1.388	1.759*
448	Nashville	−1.721*	−1.320	0.067	1.429	2.019**	−1.981**	−1.481	0.125	1.479	2.049**
444	San Antonio	−1.713*	−1.264	0.188	1.370	1.741*	−1.649*	−1.144	0.228	1.473	1.851*
430	Hampton Roads	−1.533	−1.123	0.224	1.649*	2.130**	−1.154	−0.794	0.322	1.639	2.072**
423	Salt Lake City	−1.620	−1.292	0.165	1.422	1.897*	−1.779*	−1.385	0.038	1.432	1.836*
397	Jacksonville (Florida)	−2.452**	−1.530	0.044	1.408	1.933*	−2.025**	−1.512	0.107	1.583	2.277**
384	Hartford	−1.922*	−1.338	0.413	1.744*	2.344**	−1.811*	−1.349	0.212	1.581	2.001**
355	Richmond VA	−1.525	−1.158	0.067	1.510	2.008**	−1.614	−1.332	−0.069	1.519	2.040**
331	Louisville	−3.286***	−2.127**	0.073	1.524	2.364**	−3.052***	−2.163**	−0.041	1.895*	2.786***
319	Westchester/So Connecticut	−4.592***	−2.554**	−0.141	1.303	1.855*	−7.570***	−3.991***	0.121	1.606	3.096***
304	Birmingham	−1.734*	−1.177	0.203	1.685*	2.336**	−2.191**	−1.417	0.264	1.836*	2.553**
277	Memphis	−2.488**	−1.620	0.192	2.293**	3.737***	−3.164***	−2.038**	0.052	1.953*	2.973***
269	Oklahoma City	−1.342	−1.031	0.294	1.696*	2.112**	−1.525	−1.114	0.258	1.681*	2.223**
257	Providence	−2.551**	−1.536	0.081	2.129**	3.109***	−2.837***	−1.507	−0.015	2.730***	3.869***
242	New Orleans/Metairie/Kenner	−3.460***	−2.508**	−0.140	1.398	1.924*	−3.503***	−2.237**	−0.072	1.466	2.211**
188	Buffalo/Niagara Falls	−1.288	−1.130	0.659	4.599***	7.447***	−2.523**	−1.822*	0.112	3.096***	8.814***
128	Marin/Sonoma	−4.233***	−2.349**	−0.151	1.649*	2.795***	−4.362***	−2.355**	−0.041	1.939*	3.042***

5.1. Holdback Results

The models were also backtested on the holdback sample to test the robustness of the model. The number of iterations was reduced to 200. Since the number of buildings available as subject properties was greatly reduced, significant redundancy would have been introduced with a large set of iteration. Each model was run 200 times. While the subject properties could only be drawn from the holdback sample, comparable properties were available from the whole market. The coefficients for hedonic adjustments were based on the regression results from the testing sample (80% of the market randomly drawn).

Results from backtesting on the holdback sample are presented in Tables 16 and 17 for Hedonic RHAT, or the hedonic adjusted models. Tables 18 and 19 show results for Basic RHAT, or the unadjusted estimation of expected rent.

The results were remarkably similar to the primary testing sample. The market with larger number of buildings consistently failed to reject the null in the 10th percentile tails of the distribution. The holdback results indicated that the model design was not sample specific, and should continue to perform well with other data samples. The consistent results produced no indications that the model was fitted to the data. Future tests of the model on new sets of data could further confirm the model's robustness.

Table 16: This table shows the distribution of T-statistics from 200 random draws of 5% of each market for Hedonic RHAT from the Holdback Sample. The MarketN represents the subject properties available from the holdback sample, which was 20% of the market. The comparables were drawn from the whole market. Results for adjustments based on only significant coefficients with and without Green variables are shown. The results using hedonic adjustments from all coefficients, as opposed to only significant, are shown in Table 13. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

		Percentile for Sig. Coef.					Percentile for Sig. Coef. No Green				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
649	Chicago	−1.324	−1.074	0.277	1.650*	1.864*	−1.406	−1.092	0.079	1.659*	2.110**
611	Washington DC	−1.534	−1.211	0.179	1.865*	2.405**	−0.770	−0.581	0.603	2.179**	2.612***
611	Los Angeles	−1.971**	−1.581	−0.302	1.082	1.459	−1.491	−0.977	0.485	1.650*	2.088**
472	South Florida	−3.068***	−2.675***	−1.307	0.191	0.728	−0.583	−0.303	1.122	2.497**	2.744***
445	Dallas/Ft Worth	−2.065**	−1.800*	−0.577	0.729	1.023	−0.881	−0.532	0.658	2.252**	2.745***
420	Atlanta	−2.438**	−2.123**	−1.207	0.229	0.659	−1.513	−1.226	−0.260	2.040**	2.490**
416	Northern New Jersey	−1.052	−0.825	0.352	2.017**	2.207**	−1.263	−1.138	0.167	1.793*	1.968**
401	Philadelphia	−0.708	−0.553	0.756	2.337**	2.665***	−1.953*	−1.669*	−0.619	0.903	1.336
357	Phoenix	−2.296**	−1.868*	−0.460	0.760	1.069	−0.745	−0.216	1.161	2.217**	2.458**
340	Orange (California)	−1.503	−1.182	0.135	1.345	1.825*	−1.002	−0.798	0.315	2.015**	2.252**
333	Boston	−1.437	−1.054	0.294	1.581	2.181**	−1.741*	−1.420	−0.138	1.321	1.687*
319	Houston	−2.772***	−2.368**	−1.040	0.344	0.863	−0.874	−0.568	1.137	2.162**	2.405**
314	Detroit	−1.642	−1.387	−0.221	1.195	1.645*	−1.855*	−1.714*	−0.881	0.272	0.872
283	Seattle/Puget Sound	−1.150	−0.864	0.444	1.738*	2.037**	−0.647	−0.337	0.861	2.230**	2.410**
283	Denver	−2.423**	−1.953*	−0.785	0.504	1.199	−1.323	−1.143	0.278	1.849*	2.263**
247	Minneapolis/St Paul	−2.041**	−1.761*	−0.473	0.781	0.998	−1.518	−0.919	0.595	1.508	1.731*
245	San Diego	−2.311**	−2.059**	−0.731	0.651	0.978	0.410	0.713	2.048**	3.520***	3.991***
218	'St. Louis'	−1.069	−0.610	0.657	2.158**	2.463**	−1.120	−0.855	0.384	2.263**	2.484**
218	Sacramento	−1.952*	−1.615	−0.195	1.127	1.560	−1.379	−1.040	0.383	2.174**	2.628***
215	Long Island (New York)	−1.259	−0.544	0.732	2.004**	2.400**	−1.818*	−1.463	0.074	1.375	1.629
203	Kansas City	−0.953	−0.758	0.436	2.006**	2.317**	−1.443	−1.151	−0.116	1.946*	2.389**
203	Inland Empire (California)	−1.652*	−1.283	−0.001	1.418	1.640	−1.224	−0.986	0.091	1.461	1.803*
194	Baltimore	−2.318**	−1.788*	−0.531	0.637	1.076	−0.912	−0.548	0.789	2.118**	2.428**
192	New York City	−2.882***	−2.245**	−0.693	0.827	1.089	−1.431	−0.862	0.664	1.681*	1.850*
189	Tampa/St Petersburg	−1.708*	−1.425	−0.421	1.222	1.628	−1.165	−0.930	0.308	2.323**	3.340***
172	Portland	−1.503	−0.922	0.163	1.342	1.925*	−0.790	−0.487	1.066	2.373**	2.880***
165	Columbus	−1.982**	−1.674*	−0.373	1.010	1.320	−1.866*	−1.600	0.082	1.420	1.766*
165	Las Vegas	−2.600***	−2.269**	−1.013	0.330	0.774	−1.440	−1.156	0.140	1.413	1.828*
161	East Bay/Oakland	−0.997	−0.678	0.736	1.998**	2.302**	−1.878*	−1.675*	−0.569	0.833	1.190
157	Cleveland	−1.087	−0.792	0.470	1.940*	2.517**	−1.713*	−1.319	−0.184	1.244	1.457
156	Charlotte	−1.848*	−1.651*	−0.370	1.218	1.486	−0.815	−0.595	0.956	2.326**	2.711***
155	Cincinnati/Dayton	−3.643***	−3.067***	−1.684*	−0.353	−0.024	−0.949	−0.559	0.846	2.365**	2.797***
150	Indianapolis	−3.103***	−2.579***	−0.948	0.555	0.854	−1.427	−1.019	0.257	1.706*	2.581***
148	South Bay/San Jose	−1.157	−0.864	0.229	1.637	2.053**	−1.945*	−1.642	−0.270	1.380	1.626
143	Orlando	−2.076**	−1.720*	−0.319	1.196	1.471	−1.803*	−1.406	0.151	1.449	1.898*
135	Milwaukee/Madison	−1.057	−0.862	0.435	2.198**	2.648***	−1.305	−1.175	−0.267	1.470	1.911*
135	Pittsburgh	−1.355	−1.217	−0.000	1.494	2.053**	−1.828*	−1.455	−0.451	1.241	1.544

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		Percentile for Sig. Coef.					Percentile for Sig. Coef. No Green				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
133	Austin	−2.176**	−1.893*	−0.434	0.750	1.300	−1.623	−1.394	0.135	1.346	1.692*
128	San Francisco	−1.696*	−1.121	0.320	1.889*	2.145**	−1.485	−1.078	0.137	1.624	1.954*
123	Raleigh/Durham	−2.480**	−2.001**	−0.765	0.935	1.171	−0.790	−0.457	0.923	2.557**	2.866***
106	Nashville	−1.322	−1.049	0.183	1.849*	2.375**	−1.039	−0.671	0.715	2.439**	3.035***
105	San Antonio	−1.186	−0.743	0.680	1.701*	1.946*	−1.126	−0.419	1.154	2.343**	2.854***
101	Hampton Roads	−2.611***	−2.178**	−0.692	0.516	1.020	−1.117	−0.720	0.953	2.490**	3.096***
99	Salt Lake City	−2.260**	−1.724*	−0.226	1.227	1.479	−1.005	−0.525	0.906	2.174**	2.525**
93	Jacksonville (Florida)	−2.238**	−1.915*	−0.554	1.047	1.798*	−2.733***	−2.044**	−0.548	1.062	1.400
89	Hartford	−0.725	−0.460	0.909	2.109**	2.622***	−2.368**	−1.644	−0.010	1.134	1.486
85	Richmond VA	−1.588	−1.168	0.335	1.763*	2.057**	−1.331	−1.067	0.409	1.966**	2.198**
79	Louisville	−1.856*	−1.108	0.527	1.980**	2.590***	−0.995	−0.638	0.745	2.417**	3.117***
77	Westchester/So Connecticut	−5.175***	−3.245***	−0.602	0.775	1.060	−6.366***	−4.075***	−0.255	1.073	1.387
76	Birmingham	−2.204**	−1.662*	−0.143	1.388	1.921*	−1.849*	−1.474	−0.382	1.213	1.566
71	Memphis	−1.856*	−1.089	0.551	2.306**	3.380***	−1.839*	−1.245	0.631	2.182**	3.124***
71	Oklahoma City	−1.660*	−1.413	−0.260	1.170	1.575	−1.931*	−1.475	−0.191	1.237	1.579
66	Providence	−2.476**	−2.137**	−0.058	1.432	1.931*	−2.250**	−1.748*	−0.103	1.483	1.873*
65	New Orleans/Metairie/Kenner	−2.166**	−1.752*	−0.620	1.124	1.585	−2.078**	−1.624	−0.449	1.196	1.706*
50	Buffalo/Niagara Falls	−2.954***	−1.386	0.246	2.787***	5.813***	−1.629	−1.319	0.018	2.706***	4.474***
34	Marin/Sonoma	−1.766*	−1.401	−0.112	1.782*	2.606***	−1.676*	−1.444	−0.058	1.869*	2.484**

Table 17: This table shows the distribution of T-statistics from 200 random draws of 5% of each market for Hedonic RHAT from the Holdback Sample. The MarketN represents the subject properties available from the holdback sample, which was 20% of the market. The comparables were drawn from the whole market. Results for adjustments based on all coefficients with and without Green variables are shown. The results from using only significant coefficients for hedonic adjustment, as opposed to all coefficients, are shown in Table 12. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

		Percentile for All Coef. No Green					**Percentile for All Coef.**				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
649	Chicago	−1.404	−1.170	0.037	1.509	1.742*	−1.208	−0.820	0.407	1.809*	2.381**
611	Washington DC	−1.089	−0.720	0.546	2.006**	2.279**	−1.027	−0.771	0.437	1.883*	2.214**
611	Los Angeles	−1.270	−0.890	0.327	1.713*	2.181**	−1.808*	−1.437	−0.234	1.225	1.657*
472	South Florida	−0.722	−0.198	1.157	2.597***	2.920***	−2.419**	−2.282**	−0.953	0.242	0.563
445	Dallas/Ft Worth	−0.964	−0.617	0.836	2.268**	2.828***	−2.219**	−1.865*	−0.549	0.969	1.156
420	Atlanta	−1.360	−1.085	−0.204	1.944*	2.352**	−2.474**	−2.099**	−1.261	0.033	0.515
416	Northern New Jersey	−1.307	−1.087	0.226	1.746*	2.258**	−1.202	−0.796	0.567	1.938*	2.552**
401	Philadelphia	−1.770*	−1.626	−0.589	1.014	1.392	−0.741	−0.490	0.960	2.517**	2.940***
357	Phoenix	0.081	0.331	1.417	2.410**	2.647***	−2.458**	−2.056**	−0.969	0.254	0.626
340	Orange (California)	−1.025	−0.851	0.359	1.968**	2.336**	−1.411	−1.097	0.358	1.736*	2.019**
333	Boston	−1.551	−1.333	−0.044	1.320	1.680*	−1.214	−0.809	0.470	1.808*	2.136**
319	Houston	−0.828	−0.528	0.893	2.282**	2.580***	−2.772***	−2.269**	−1.096	0.195	0.409
314	Detroit	−1.732*	−1.567	−0.683	0.782	1.525	−1.903*	−1.630	−0.273	1.222	1.336
283	Seattle/Puget Sound	−0.962	−0.600	0.777	2.113**	2.588***	−1.154	−0.848	0.449	1.742*	2.121**
283	Denver	−1.394	−1.037	0.080	1.410	1.723*	−2.293**	−2.010**	−0.728	0.418	0.902
247	Minneapolis/St Paul	−1.217	−0.893	0.472	1.603	2.111**	−2.559**	−2.120**	−0.525	0.870	1.170
245	San Diego	0.197	0.572	1.791*	3.293***	3.825***	−2.507**	−2.002**	−0.699	0.613	0.929
218	'St. Louis'	−1.152	−0.921	0.216	1.931*	2.440**	−1.207	−0.743	0.598	2.110**	2.363**
218	Sacramento	−1.225	−0.860	0.397	1.938*	2.375**	−2.192**	−1.709*	−0.318	0.974	1.319
215	Long Island (New York)	−1.817*	−1.267	0.166	1.081	1.328	−1.028	−0.729	0.770	1.831*	2.128**
203	Kansas City	−1.324	−1.085	−0.066	1.664*	2.184**	−1.083	−0.687	0.455	1.677*	1.943*
203	Inland Empire (California)	−1.108	−0.836	0.365	1.658*	2.147**	−1.487	−1.062	0.273	1.361	1.693*
194	Baltimore	−0.707	−0.312	0.820	2.274**	2.453**	−1.776*	−1.634	−0.297	1.228	1.555
192	New York City	−1.577	−1.037	0.572	1.701*	1.901*	−2.196**	−1.900*	−0.269	0.965	1.202
189	Tampa/St Petersburg	−1.214	−0.871	0.541	2.471**	2.896***	−1.654*	−1.376	−0.280	1.292	1.814*
172	Portland	−0.724	−0.449	1.090	2.475**	2.866***	−1.521	−1.191	−0.107	1.294	1.784*
165	Columbus	−1.614	−1.343	0.041	1.333	1.620	−2.193**	−1.811*	−0.381	1.085	1.621
165	Las Vegas	−1.656*	−1.173	0.137	1.271	1.602	−2.800***	−2.338**	−0.947	0.281	0.675
161	East Bay/Oakland	−1.940*	−1.720*	−0.522	0.762	1.193	−0.991	−0.801	0.548	1.854*	2.178**
157	Cleveland	−1.590	−1.233	0.085	1.455	1.753*	−1.152	−0.935	0.523	1.835*	2.288**
156	Charlotte	−1.233	−1.032	0.521	1.820*	2.454**	−2.208**	−1.556	−0.271	1.179	1.419
155	Cincinnati/Dayton	−1.174	−0.781	0.544	2.162**	2.576**	−3.638***	−2.960***	−1.636	−0.178	0.048
150	Indianapolis	−1.244	−0.799	0.516	1.611	2.286**	−2.585***	−2.357**	−0.974	0.528	0.928
148	South Bay/San Jose	−2.231**	−1.837*	−0.328	1.034	1.441	−1.333	−0.999	0.261	1.762*	2.059**
143	Orlando	−1.699*	−1.293	0.011	1.374	1.683*	−2.539**	−1.722*	−0.443	1.317	2.003**
135	Milwaukee/Madison	−1.433	−1.268	−0.500	1.172	1.517	−0.753	−0.580	0.560	2.400**	2.850***

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		Percentile for All Coef. No Green					Percentile for All Coef.				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
135	Pittsburgh	−1.818*	−1.540	−0.195	1.279	1.783*	−1.501	−1.276	0.230	1.712*	2.499**
133	Austin	−1.982**	−1.506	−0.010	1.218	1.477	−2.458**	−1.998**	−0.609	0.778	1.035
128	San Francisco	−1.547	−1.268	0.227	1.881*	2.334**	−1.552	−1.154	0.187	1.443	2.036**
123	Raleigh/Durham	−0.539	−0.304	1.062	2.594***	3.027***	−2.768***	−2.102**	−0.466	1.039	1.448
106	Nashville	−1.113	−0.862	0.543	2.463**	2.826***	−1.417	−1.027	0.175	1.595	2.198**
105	San Antonio	−0.972	−0.513	0.760	2.088**	2.386**	−1.535	−0.940	0.602	1.594	1.761*
101	Hampton Roads	−1.310	−0.788	0.687	1.959*	2.256**	−2.385**	−1.925*	−0.582	0.673	1.251
99	Salt Lake City	−0.766	−0.464	1.032	2.061**	2.760***	−2.608***	−2.129**	−0.200	1.225	1.503
93	Jacksonville (Florida)	−3.067***	−2.498**	−0.531	0.954	1.114	−2.063**	−1.799*	−0.384	1.292	1.692*
89	Hartford	−2.228**	−1.705*	−0.153	1.251	1.672*	−0.899	−0.506	1.029	2.420**	2.792***
85	Richmond VA	−1.333	−1.071	0.428	1.536	1.958*	−1.467	−1.123	0.358	1.873*	2.264**
79	Louisville	−1.084	−0.715	0.892	2.291**	3.111***	−1.389	−1.022	0.437	2.021**	2.417**
77	Westchester/So Connecticut	−3.190***	−2.257**	−0.022	1.050	1.554	−5.444***	−3.008***	−0.552	0.993	1.258
76	Birmingham	−1.779*	−1.483	−0.263	1.196	1.653*	−1.749*	−1.400	−0.112	1.628	2.085**
71	Memphis	−2.108**	−0.754	0.707	2.487**	3.104***	−1.651*	−0.839	0.812	2.620***	3.678***
71	Oklahoma City	−1.762*	−1.329	−0.117	1.321	2.030**	−1.994**	−1.499	−0.286	1.510	2.363**
66	Providence	−2.027**	−1.581	0.140	1.657*	1.974**	−2.245**	−1.956*	−0.165	1.205	1.623
65	New Orleans/Metairie/Kenner	−2.042**	−1.679*	−0.431	1.373	1.915*	−2.288**	−1.734*	−0.387	1.265	2.143**
50	Buffalo/Niagara Falls	−2.393**	−1.674*	−0.114	2.303**	4.373***	−2.416**	−1.585	0.301	4.431***	5.831***
34	Marin/Sonoma	−1.883*	−1.507	0.246	1.772*	2.404**	−1.727*	−1.201	0.018	1.737*	2.673***

Table 18: This table shows the distribution of T-statistics from 200 random draws of 5% of each market for Basic RHAT from the Holdback Sample. The MarketN represents the subject properties available from the holdback sample, which was 20% of the market. The comparables were drawn from the whole market. Results for comparable selection based on sum of squares from only significant coefficients with and without Green variables are shown. The results using hedonic adjustments from all coefficients, as opposed to only significant, are shown in Table 9. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

		Percentile for Sig. Coef.					**Percentile for Sig. Coef. No Green**				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
649	Chicago	−1.705*	−1.377	−0.166	1.403	1.891*	−1.199	−1.004	−0.010	1.637	2.089**
611	Washington DC	−1.269	−0.948	0.370	2.120**	2.577***	−1.300	−0.843	0.538	2.115**	2.548**
611	Los Angeles	−2.059**	−1.673*	−0.464	0.891	1.107	−1.992**	−1.718*	−0.201	0.886	1.108
472	South Florida	−1.042	−0.839	0.535	1.867*	2.142**	−0.809	−0.594	0.832	2.109**	2.395**
445	Dallas/Ft Worth	−1.377	−0.942	0.520	2.004**	2.296**	−1.037	−0.732	0.453	2.249**	2.691***
420	Atlanta	−1.961**	−1.854*	−0.937	0.505	1.266	−1.884*	−1.632	−0.762	1.072	1.482
416	Northern New Jersey	−1.253	−1.107	−0.056	1.515	1.809*	−1.292	−1.150	0.093	1.632	1.905*
401	Philadelphia	−1.823*	−1.585	−0.644	0.703	0.981	−1.872*	−1.642	−0.506	1.100	1.454
357	Phoenix	−0.875	−0.574	0.648	1.690*	2.085**	−0.840	−0.331	1.192	2.201**	2.560**
340	Orange (California)	−1.515	−1.250	−0.170	1.169	1.521	−1.370	−1.105	0.043	1.649*	1.945*
333	Boston	−1.988**	−1.724*	−0.241	1.289	1.720*	−1.727*	−1.493	−0.315	1.226	1.565
319	Houston	−0.982	−0.841	0.630	1.902*	2.233**	−1.113	−0.825	0.808	1.901*	2.169**
314	Detroit	−1.854*	−1.643	−0.630	1.278	1.960*	−1.861*	−1.668*	−0.770	0.460	1.053
283	Seattle/Puget Sound	−1.242	−0.865	0.464	2.225**	2.448**	−0.938	−0.494	0.969	2.540**	2.894***
283	Denver	−0.873	−0.557	0.711	2.136**	2.627***	−1.007	−0.810	0.738	2.271**	2.727***
247	Minneapolis/St Paul	−1.763*	−1.302	0.283	1.418	1.650*	−1.671*	−1.001	0.491	1.401	1.685*
245	San Diego	−0.308	−0.033	1.141	2.328**	2.793***	−0.364	−0.080	1.040	2.477**	2.807***
218	'St. Louis'	−1.425	−1.084	−0.118	1.842*	2.521**	−1.373	−1.064	−0.040	1.727*	2.078**
218	Sacramento	−0.890	−0.759	0.546	2.170**	2.497**	−1.330	−0.979	0.568	2.257**	2.632***
215	Long Island (New York)	−1.540	−1.216	0.361	1.398	1.780*	−1.986**	−1.558	0.117	1.287	1.502
203	Kansas City	−1.565	−1.256	−0.089	1.438	2.058**	−1.311	−1.085	−0.076	2.049**	2.412**
203	Inland Empire (California)	−1.243	−0.810	0.493	1.875*	2.241**	−0.931	−0.722	0.456	1.984**	2.455**
194	Baltimore	−0.950	−0.673	0.713	2.142**	2.522**	−0.875	−0.643	0.731	2.091**	2.372**
192	New York City	−2.099**	−1.616	0.383	1.405	1.678*	−1.560	−0.952	0.702	1.516	1.811*
189	Tampa/St Petersburg	−1.297	−1.140	−0.242	1.234	1.762*	−1.343	−1.085	−0.112	1.900*	2.523**
172	Portland	−1.240	−0.969	0.552	1.782*	2.053**	−1.199	−0.812	0.580	1.863*	2.281**
165	Columbus	−1.893*	−1.538	0.085	1.288	1.622	−2.028**	−1.624	−0.174	1.111	1.626
165	Las Vegas	−1.073	−0.728	0.620	1.817*	2.089**	−1.298	−0.807	0.412	1.803*	2.145**
161	East Bay/Oakland	−1.917*	−1.573	−0.370	0.787	1.108	−1.634	−1.424	−0.393	1.091	1.656*
157	Cleveland	−1.393	−1.199	0.055	1.587	1.789*	−1.501	−1.332	−0.204	1.406	1.949*
156	Charlotte	−1.296	−0.863	0.430	1.962**	2.145**	−0.997	−0.779	0.655	2.110**	2.532**
155	Cincinnati/Dayton	−1.235	−1.028	−0.056	1.861*	2.019**	−1.475	−1.232	0.106	1.534	2.272**
150	Indianapolis	−1.521	−1.110	0.305	1.338	1.527	−1.725*	−1.336	0.112	1.464	1.698*
148	South Bay/San Jose	−1.627	−1.416	−0.102	1.415	1.860*	−1.696*	−1.386	0.109	1.435	1.991**
143	Orlando	−1.920*	−1.628	−0.077	1.402	1.692*	−1.881*	−1.408	0.077	1.576	2.004**
135	Milwaukee/Madison	−1.590	−1.381	−0.419	1.263	1.483	−1.398	−1.280	−0.411	1.557	1.964**
135	Pittsburgh	−1.440	−1.282	−0.133	1.447	1.878*	−1.839*	−1.503	−0.381	1.242	1.596

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		Percentile for Sig. Coef.					Percentile for Sig. Coef. No Green				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
133	Austin	−1.725*	−1.448	0.086	1.126	1.597	−1.653*	−1.358	0.008	1.268	1.669*
128	San Francisco	−2.248**	−1.888*	−0.292	1.163	1.673*	−2.013**	−1.578	−0.347	1.167	1.424
123	Raleigh/Durham	−0.962	−0.658	0.878	2.113**	2.518**	−0.719	−0.413	0.880	2.423**	2.893***
106	Nashville	−0.829	−0.593	0.751	2.910***	3.680***	−0.815	−0.565	1.091	3.026***	3.955***
105	San Antonio	−2.736***	−2.224**	−0.558	0.781	1.058	−2.780***	−2.240**	−0.566	0.695	1.021
101	Hampton Roads	−1.756*	−1.595	−0.100	1.178	1.655*	−1.321	−1.065	0.367	1.885*	2.389**
99	Salt Lake City	−1.184	−0.765	0.563	1.652*	1.908*	−1.433	−0.847	0.666	1.844*	2.515**
93	Jacksonville (Florida)	−2.556**	−2.063**	−0.374	1.235	1.841*	−2.106**	−1.738*	−0.427	0.948	1.623
89	Hartford	−1.115	−0.727	0.523	1.884*	2.534**	−1.383	−1.015	0.723	2.056**	2.562**
85	Richmond VA	−1.608	−1.333	0.071	1.415	1.659*	−1.581	−1.221	0.149	1.595	1.834*
79	Louisville	−1.636	−1.003	0.687	2.113**	2.556**	−1.190	−0.867	0.673	2.187**	2.804***
77	Westchester/So Connecticut	−3.831***	−2.709***	−0.626	1.016	1.675*	−4.028***	−3.016***	−0.708	0.912	1.161
76	Birmingham	−1.673*	−1.385	−0.484	1.288	1.796*	−1.743*	−1.441	−0.311	1.226	1.524
71	Memphis	−1.586	−0.687	0.603	1.865*	2.508**	−2.380**	−1.546	0.429	1.770*	2.112**
71	Oklahoma City	−1.494	−1.170	0.320	1.717*	2.395**	−1.574	−1.179	0.301	1.748*	2.048**
66	Providence	−1.682*	−1.344	−0.033	1.254	1.700*	−1.579	−1.365	0.103	1.406	1.863*
65	New Orleans/Metairie/Kenner	−2.026**	−1.686*	−0.443	1.068	1.387	−2.180**	−1.730*	−0.470	1.235	1.388
50	Buffalo/Niagara Falls	−2.085**	−1.632	−0.018	1.889*	2.791***	−1.753*	−1.248	0.033	1.889*	2.791***
34	Marin/Sonoma	−2.081**	−1.542	−0.455	1.880*	2.730***	−1.932*	−1.460	−0.295	2.148**	3.759***

Table 19: This table shows the distribution of T-statistics from 200 random draws of 5% of each market for Basic RHAT from the Holdback Sample. The MarketN represents the subject properties available from the holdback sample, which was 20% of the market. The comparables were drawn from the whole market. Results for comparable selection based on sum of squares from all coefficients with and without Green variables are shown. The results from using only significant coefficients for hedonic adjustment, as opposed to all coefficients, are shown in Table 8. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

		Percentile for All Coef. No Green					**Percentile for All Coef.**				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
649	Chicago	−1.341	−1.098	0.099	1.683*	2.309**	−1.504	−1.210	0.094	1.607	1.928*
611	Washington DC	−1.247	−0.933	0.454	2.181**	2.592***	−1.173	−0.883	0.375	1.586	2.323**
611	Los Angeles	−2.094**	−1.605	−0.369	1.020	1.367	−2.135**	−1.741*	−0.327	0.962	1.122
472	South Florida	−1.052	−0.784	0.720	2.112**	2.271**	−1.030	−0.646	0.599	2.043**	2.339**
445	Dallas/Ft Worth	−1.247	−0.676	0.779	2.308**	2.596***	−1.190	−0.747	0.599	1.797*	2.060**
420	Atlanta	−1.679*	−1.467	−0.677	0.840	1.352	−1.934*	−1.768*	−0.872	0.643	1.069
416	Northern New Jersey	−1.284	−1.096	0.181	1.755*	2.018**	−1.449	−1.242	0.142	1.677*	1.952*
401	Philadelphia	−1.816*	−1.578	−0.517	1.127	1.690*	−1.841*	−1.646*	−0.696	0.885	1.473
357	Phoenix	−0.283	0.152	1.131	2.188**	2.458**	−1.338	−0.975	0.495	1.726*	2.172**
340	Orange (California)	−1.560	−1.260	−0.164	1.496	1.863*	−1.708*	−1.278	0.120	1.357	1.513
333	Boston	−1.713*	−1.504	−0.135	1.338	1.605	−1.930*	−1.516	−0.211	1.141	1.535
319	Houston	−0.934	−0.738	0.765	2.005**	2.236**	−1.057	−0.788	0.692	1.937*	2.270**
314	Detroit	−1.645*	−1.470	−0.572	0.923	1.789*	−1.919*	−1.685*	−0.641	0.899	1.343
283	Seattle/Puget Sound	−0.947	−0.604	0.957	2.562**	2.889***	−1.172	−0.909	0.454	2.094**	2.321**
283	Denver	−0.890	−0.692	0.813	2.033**	2.244**	−0.971	−0.719	0.687	1.993**	2.381**
247	Minneapolis/St Paul	−1.278	−0.994	0.383	1.584	2.064**	−1.928*	−1.673*	0.303	1.325	1.652*
245	San Diego	−0.434	−0.204	1.167	2.311**	2.776***	−0.515	−0.351	0.902	2.298**	2.729***
218	'St. Louis'	−1.377	−1.134	−0.178	1.479	1.815*	−1.411	−1.202	0.035	1.635	1.975**
218	Sacramento	−1.021	−0.770	0.729	2.147**	2.584***	−1.166	−0.864	0.309	2.026**	2.574**
215	Long Island (New York)	−1.488	−1.231	0.141	1.196	1.395	−1.539	−1.156	0.389	1.427	1.588
203	Kansas City	−1.207	−1.061	0.023	1.698*	2.201**	−1.394	−1.163	−0.220	1.815*	2.333**
203	Inland Empire (California)	−0.825	−0.566	0.724	2.234**	2.567**	−1.001	−0.649	0.714	1.940*	2.196**
194	Baltimore	−0.713	−0.435	0.792	2.242**	2.563**	−0.977	−0.484	0.953	2.266**	2.782***
192	New York City	−1.623	−1.091	0.708	1.621	1.876*	−1.675*	−1.220	0.579	1.586	1.842*
189	Tampa/St Petersburg	−1.447	−1.168	0.239	2.043**	2.367**	−1.415	−1.199	−0.213	1.582	1.985**
172	Portland	−0.951	−0.760	0.675	1.953*	2.319**	−1.081	−0.861	0.400	1.755*	2.045**
165	Columbus	−1.767*	−1.490	−0.097	1.261	1.652*	−2.101**	−1.733*	−0.100	1.327	1.732*
165	Las Vegas	−1.024	−0.669	0.675	1.613	1.859*	−1.249	−0.822	0.546	1.829*	2.379**
161	East Bay/Oakland	−1.856*	−1.493	−0.397	1.157	1.675*	−1.971**	−1.685*	−0.456	1.044	1.667*
157	Cleveland	−1.228	−1.100	0.058	1.742*	2.148**	−1.365	−1.080	−0.015	1.736*	2.105**
156	Charlotte	−1.337	−1.108	0.346	1.912*	2.254**	−1.362	−1.039	0.392	1.781*	2.050**
155	Cincinnati/Dayton	−1.440	−1.227	−0.073	1.390	1.759*	−1.498	−1.220	0.074	1.522	1.879*
150	Indianapolis	−1.500	−1.115	0.213	1.378	1.649*	−1.598	−1.241	0.291	1.425	1.610
148	South Bay/San Jose	−1.803*	−1.608	−0.041	1.349	1.782*	−1.670*	−1.385	−0.053	1.472	1.811*
143	Orlando	−1.604	−1.190	−0.030	1.417	1.771*	−1.705*	−1.355	−0.212	1.320	1.695*
135	Milwaukee/Madison	−1.329	−1.197	−0.523	1.326	1.912*	−1.416	−1.258	−0.445	1.546	2.159**

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		Percentile for All Coef. No Green					Percentile for All Coef.				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
135	Pittsburgh	−1.801*	−1.527	−0.172	1.329	1.829*	−1.654*	−1.430	0.046	1.511	1.896*
133	Austin	−1.745*	−1.491	0.137	1.159	1.470	−1.815*	−1.480	−0.065	1.196	1.311
128	San Francisco	−1.824*	−1.526	−0.319	1.173	1.539	−2.014**	−1.698*	−0.405	1.111	1.375
123	Raleigh/Durham	−0.583	−0.378	1.129	2.459**	2.934***	−0.906	−0.628	0.984	2.464**	2.906***
106	Nashville	−0.776	−0.632	1.105	3.391***	3.919***	−0.856	−0.617	0.978	3.006***	3.902***
105	San Antonio	−2.698***	−2.163**	−0.702	0.782	1.051	−2.616***	−2.234**	−0.668	0.643	0.930
101	Hampton Roads	−1.837*	−1.400	0.160	1.388	1.717*	−1.872*	−1.651*	−0.214	1.093	1.708*
99	Salt Lake City	−1.441	−1.042	0.707	1.712*	1.951*	−1.369	−0.920	0.554	1.777*	2.131**
93	Jacksonville (Florida)	−2.676***	−1.959*	−0.549	0.679	1.018	−2.134**	−1.575	−0.333	0.841	1.552
89	Hartford	−1.263	−0.834	0.530	1.853*	2.313**	−1.587	−1.085	0.701	2.001**	2.234**
85	Richmond VA	−1.633	−1.336	0.042	1.321	1.869*	−1.568	−1.258	0.306	1.553	1.789*
79	Louisville	−1.199	−0.844	0.852	2.373**	2.966***	−1.326	−0.652	0.960	2.392**	2.736***
77	Westchester/So Connecticut	−2.777***	−2.156**	−0.604	1.032	1.371	−3.578***	−2.392**	−0.513	0.987	1.648*
76	Birmingham	−2.030**	−1.622	−0.529	1.015	1.560	−2.315**	−1.547	−0.452	1.288	1.718*
71	Memphis	−2.264**	−1.260	0.417	1.729*	2.474**	−2.386**	−1.462	0.507	1.850*	2.658***
71	Oklahoma City	−1.408	−1.076	0.249	2.025**	2.783***	−1.350	−1.116	0.150	2.114**	2.707***
66	Providence	−1.893*	−1.432	0.006	1.585	1.942*	−1.934*	−1.373	−0.029	1.408	1.648*
65	New Orleans/Metairie/Kenner	−2.151**	−1.706*	−0.433	1.265	1.449	−2.215**	−1.807*	−0.450	1.282	1.515
50	Buffalo/Niagara Falls	−1.998**	−1.622	−0.165	1.975**	2.461**	−1.497	−1.308	−0.075	2.112**	2.590***
34	Marin/Sonoma	−1.816*	−1.204	−0.192	1.751*	2.425**	−1.959*	−1.633	−0.505	2.062**	2.433**

5.2. Control Tests

The results suggested the core model effectively estimates expected rent based on the comparables. However, I wanted to be sure that the results were not the result of averaging over a large N. To test this, I ran a control set.

The control parameters matched the subject building to a building that was at least 10 size categories larger; there were 20 total categories per market. In general, larger buildings tend to command higher rents. The model used the less stringent matching criteria where applicable. If the model was working efficiently, it should reject the null consistently for the Basic RHAT, or unadjusted sample. The results are shown in Table 20.

The control tests showed that, in most markets, the null was consistently rejected. The expected rent exceeded the observed rent, as one would expect for the purposely mis-matched buildings.

The Hedonic RHAT, or adjusted model, should significantly compensate for the size differential through the hedonic coefficient adjustments. Again, the results confirmed that the hedonic adjustments were effectively matching expected rents to observed rents. Certainly, the model performed worse than in properly matched sets, but that was expected. The results did indicate that the adjustments were helping the matching process.

One critical finding in the control tests was that purposeful mismatching could identify market differences. This finding opens the door for future researchers to investigate potential market inefficiencies or premiums through this method.

Table 20: This table shows the distribution of T-statistics from 200 random draws of 5% of each market for the Control Sample. Properties were matched to properties that were 10 (of 20 total) categories higher in size. Basic RHAT, or the unadjusted matches and Hedonic RHAT, or the adjusted by hedonic coefficients, matches are shown. Significant coefficients are shown in Table 8. ***,**,* represent statistical significance at the 1%, 5%, and 10% levels respectively.

		Basic RHAT					**Hedonic RHAT**				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
2606	Chicago	−2.982***	−2.667***	−1.379	−0.360	0.094	−0.307	−0.512	0.946	2.335**	2.878***
2455	Washington DC	−7.051***	−6.497***	−4.954***	−3.402***	−2.831***	1.612	2.192**	3.729***	5.370***	6.037***
2447	Los Angeles	−4.752***	−4.074***	−2.678***	−1.142	−0.902	−1.777*	−1.462	0.021	1.352	1.652*
1945	South Florida	−3.618***	−3.156***	−1.897*	−0.624	−0.217	−1.698*	−1.055	0.314	1.611	1.983**
1846	Dallas/Ft Worth	−4.662***	−4.398***	−3.189***	−1.849*	−1.521	−2.683***	−2.298**	−0.986	0.168	0.493
1742	Atlanta	−5.326***	−4.736***	−3.400***	−2.066**	−1.734*	−1.514	−0.946	0.485	2.014**	2.249**
1723	Northern New Jersey	−3.821***	−3.341***	−1.874*	−0.560	−0.160	−1.704*	−1.165	0.192	1.645	1.985**
1661	Philadelphia	−1.895*	−1.489	−0.279	1.216	1.546	−0.985	−0.558	0.631	2.009**	2.361**
1471	Phoenix	−5.438***	−4.693***	−3.368***	−2.192**	−1.602	−2.290**	−1.938*	−0.618	0.749	1.109
1415	Orange (California)	−3.111***	−2.587***	−1.253	0.107	0.373	−1.855*	−1.443	−0.137	1.361	1.710*
1386	Boston	−2.964***	−2.567**	−1.155	0.091	0.457	−1.281	−0.889	0.491	1.668*	2.030**
1323	Houston	−5.393***	−4.757***	−3.095***	−1.516	−1.232	−1.782*	−1.640	−0.280	0.982	1.253
1300	Detroit	−3.484***	−3.059***	−1.921*	−0.535	−0.194	−1.750*	−1.483	−0.320	0.996	1.266
1187	Seattle/Puget Sound	−4.231***	−3.652***	−2.206**	−0.815	−0.251	−1.564	−1.204	0.125	1.358	1.955*
1177	Denver	−5.866***	−4.957***	−3.313***	−1.815*	−1.375	−2.287**	−1.983**	−0.595	0.671	1.172
1009	Minneapolis/St Paul	−2.077**	−1.590	−0.350	0.943	1.411	−2.142**	−1.680*	−0.330	0.858	1.333
983	San Diego	−6.133***	−5.746***	−3.731***	−2.289**	−1.853*	−2.238**	−1.786*	−0.530	0.725	1.109
881	'St. Louis'	−3.476***	−3.062***	−1.685*	−0.391	−0.084	−1.128	−0.618	0.614	1.886*	2.347**
876	Sacramento	−2.491**	−2.041**	−0.823	0.507	1.103	−1.977**	−1.649*	−0.361	0.962	1.353
867	Long Island (New York)	−3.091***	−2.565**	−0.920	0.361	0.571	−0.891	−0.516	0.822	2.278**	2.491**
804	Kansas City	−3.153***	−2.825***	−1.700*	−0.411	0.142	−1.113	−0.623	0.495	2.198**	2.592***
801	Inland Empire (California)	−3.945***	−3.553***	−1.974**	−0.567	−0.162	−1.863*	−1.541	−0.293	1.228	1.625
785	Baltimore	−5.441***	−4.598***	−3.143***	−1.452	−1.210	−1.956*	−1.641	−0.121	1.177	1.768*
777	New York City	−3.058***	−2.392**	−0.495	0.798	1.121	−3.638***	−3.106***	−1.122	0.340	0.700
769	Tampa/St Petersburg	−5.487***	−4.693***	−2.770***	−1.422	−1.009	−0.805	−0.619	1.044	2.899***	3.393***
714	Portland	−3.262***	−2.915***	−1.244	0.131	0.456	−1.477	−1.112	0.241	1.586	2.178**
689	Columbus	−2.194**	−1.928*	−0.829	0.273	0.518	−1.155	−0.869	0.412	1.772*	2.016**
689	Las Vegas	−4.825***	−4.277***	−2.564**	−1.182	−0.859	−1.714*	−1.139	0.124	1.650*	2.098**
676	East Bay/Oakland	−3.775***	−3.427***	−1.936*	−0.341	0.154	−2.425**	−1.924*	−0.618	0.867	1.268
652	Cleveland	−3.355***	−2.799***	−1.312	0.015	0.598	−1.556	−1.166	0.518	1.875*	2.399**
651	Charlotte	−3.351***	−2.873***	−1.436	−0.180	0.242	−1.593	−1.300	−0.010	1.503	1.821*
642	Cincinnati/Dayton	−2.503**	−2.108**	−0.860	0.271	0.635	−1.054	−0.675	0.789	2.494**	3.242***
620	Indianapolis	−3.197***	−3.053***	−1.419	−0.044	0.289	−1.503	−1.062	0.342	1.859*	2.338**
617	South Bay/San Jose	−2.861***	−2.256**	−0.757	0.480	0.734	−3.069***	−2.595***	−1.018	0.350	0.658
	*Small sample issues possible below 600 N										
598	Orlando	−4.381***	−3.720***	−1.949*	−0.703	−0.300	−1.115	−0.724	0.354	2.348**	2.895***
569	Milwaukee/Madison	−1.385	−1.043	0.306	1.835*	2.419**	−1.222	−0.736	0.360	1.881*	2.493**

continued on the next page

		Basic RHAT					Hedonic RHAT				
marketn	**marketname**	**5th**	**10th**	**Median**	**90th**	**95th**	**5th**	**10th**	**Median**	**90th**	**95th**
567	Pittsburgh	−4.825***	−3.782***	−2.127**	−0.687	−0.349	−1.780*	−1.064	0.360	1.690*	2.288**
560	Austin	−2.992***	−2.351**	−0.913	0.282	0.962	−1.865*	−1.110	0.021	1.637	2.260**
538	San Francisco	−4.559***	−4.175***	−1.951*	−0.617	−0.301	−2.037**	−1.646*	−0.141	1.135	1.657*
519	Raleigh/Durham	−4.779***	−4.260***	−2.696***	−1.345	−0.858	−2.109**	−1.691*	−0.306	1.257	1.751*
448	Nashville	−8.893***	−6.010***	−2.738***	−0.661	−0.290	−2.165**	−1.252	0.317	2.339**	3.021***
444	San Antonio	−5.911***	−4.927***	−2.976***	−1.683*	−1.263	−2.166**	−1.570	−0.514	1.167	1.509
430	Hampton Roads	−3.443***	−3.187***	−1.753*	−0.306	0.126	−1.531	−1.329	0.060	1.896*	2.443**
423	Salt Lake City	−5.644***	−4.826***	−2.924***	−1.509	−1.077	−2.731***	−1.865*	−0.693	0.798	1.113
397	Jacksonville (Florida)	−4.898***	−3.309***	−0.921	0.313	0.722	−2.208**	−1.685*	−0.294	1.324	1.732*
384	Hartford	−5.004***	−3.926***	−1.770*	−0.255	0.071	−3.260***	−2.579***	−0.498	1.175	1.769*
355	Richmond VA	−5.364***	−3.962***	−2.392**	−1.231	−0.909	−1.728*	−1.223	0.017	1.668*	2.240**
331	Louisville	−8.259***	−6.592***	−2.720***	−1.224	−0.857	−1.801*	−1.365	−0.185	1.472	2.034**
319	Westchester/So Connecticut	−7.761***	−5.078***	−1.876*	−0.270	0.216	−2.330**	−1.555	0.117	2.173**	3.654***
304	Birmingham	−5.643***	−4.276***	−1.719*	−0.187	0.241	−2.811***	−1.972**	−0.097	1.218	1.764*
277	Memphis	−5.407***	−3.917***	−1.913*	−0.606	0.021	−1.200	−0.930	0.606	2.497**	3.909***
269	Oklahoma City	−4.338***	−3.361***	−0.768	0.510	1.075	−1.649*	−1.341	0.018	2.269**	3.441***
257	Providence	−3.745***	−3.359***	−1.193	0.216	0.775	−1.838*	−1.308	0.208	2.628***	3.859***
242	New Orleans/Metairie/Kenner	−9.569***	−7.179***	−2.482**	−0.493	−0.346	−2.447**	−1.766*	−0.310	1.874*	2.511**
188	Buffalo/Niagara Falls	−4.266***	−2.417**	−0.434	1.598	2.406**	−4.801***	−2.684***	−0.240	1.374	2.079**
128	Marin/Sonoma	−6.226***	−4.624***	−1.579	−0.014	0.301	−4.416***	−2.374**	0.213	1.503	2.553**

6. Conclusion

This paper presented a theoretical basis for the use of alternative real estate estimation models to pure hedonic regressions. Several articles in the extant literature (Bowden, 1992; Ekeland et al., 2002; Epple, 1987; Malpezzi, 2002) have outlined potential flaws in hedonic regression. When exploring national data sets, the use of linear adjustments may not effectively capture market by market complexities. Dummy variable may become inconsistent through the incidental parameter issues (Baltagi and Kao, 2001). Also, national regressions impose supply and demand factors across markets, when the extant literature clearly demonstrated market by market differences (Chichernea et al., 2008).

This article presented one of the first alternative models for real estate value and baseline normal return estimations in the literature. The empirical results demonstrated consistent application of the theoretical model to real life data. The first model was a basic matching model, based on the grid method. The automated algorithm selected 3-10 comparable properties, and estimated an expected rent. The second model, hedonic matching, built upon the first; it used hedonic regression coefficients from the subject market to adjust the expected rent calculations based on the attribute differences of the subject and comparable properties.

The theoretical model presented was an objective, repeatable method using matching with the CoStar database. The core models demonstrated consistent failure to reject the null hypothesis of no difference between expected and observed rent in the 10th and 90th percentile tails of the distribution. Strongest performance was observed in larger markets, with more comparables from which to select.

Two version of the model were tested, and the results from nearly 20 Million iterations of the model were shown. The null hypothesis of no difference in rent from Hypotheses 1 and 2 was consistently rejected in the tails of the 500 test distributions. The Hedonic RHAT model, which adjusted the expected rent using the hedonic coefficients as the adjustment parameters effectively estimated expected rent. The Basic RHAT model, which selected comparables and averaged their rent to estimated expected rent, performed with similar efficiency.

In addition, tests of a holdback sample indicated that the model was not fit to the data, and suggested flexibility and adaptability of the model to other data sets. While this was designed for use with the CoStar database, the model could be easily adapted to other national CRE databases as they may become available to researchers.

A control model was also examined, and the control confirmed two key components of the model's efficacy. The Basic RHAT, or unadjusted model, showed that purposeful mismatching could identify market differences. This critical finding showed that the model could be used to identify potential market inefficiencies or premiums through that method. Also, the Hedonic RHAT, or adjusted model, showed relative robustness to purposeful mismatching. It performed adjustments to significantly improve expected rent calculations.

Like any new normative model, the author recognizes that future research could further improve its performance. The author invites other scholars to continue improving upon the strong foundation laid out here[12]. In addition, to academic opportunities, the further refinement of this model into practitioner based application is a real opportunity. Practitioners may benefit from the use of hedonic adjustments over subjective ones.

New research opportunities stemming from this paper are abundant. In addition to the further refinement of the model, confirmation or rejection of a wide range of prior findings can be tested using this method. Differences in size, stories, view premiums, or other building attributes could be purposefully mismatched to identify premiums.

Another potential research avenue is a detailed comparison of stand-alone hedonic regression to matching in a constructed data set.

Increased data availability for real estate researchers may represent the beginning of new age in real estate research. No longer confined to private, one-off data sets, researchers can now begin to investigate the best way to research. Alternative research methods may open the door to a host of fresh findings, and new ideas in the field.

[12]Base code is available from the author by request to qualified researchers.

It is the author's hope that this articles represents merely the start of a new age in empirical real estate research.

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Conclusion

Managing Well by Managing Good represents the first evidence that some of the Sustainable Real Estate rent premiums, specifically Energy Star and Dual building premiums, previously shown in the literature were neither theoretically or empirically supported. A fundamental mismatch in financial motivation based on lease structure summarizes the key theoretical argument against Energy Star rental premiums.. The bulk of ESTAR leases, 61%, were FSG compared to only 14% NNN. In a FSG lease, the tenant receives no benefit from reduced operating expenses. since energy savings ultimately go to the building owner, renters have no incentive to overpay. Essentially, a commercial broker would be saying to their tenant client, "I know this building cost more to rent, but you're saving the building owner energy costs!"

The paper showed that perhaps Energy Star premiums where actually capturing superior management skill rather than sustainability premiums. Professional ownership was found to be significant, and in most regressions it dominated the ESTAR premium.

I presented arguments that the use of OLSDV regression with too many dummy variables can potentially lead to inconsistent dummy variable estimations (Baltagi and Kao, 2001). Furthermore, the use of a single linear adjustment to the dependent variable likely fails to adequately capture the market by market complexities of the data. The use of fixed effects and a within transformation of each variable with market fixed effects led to more consistent and reliable building attribute values.

Rental findings first found, similar to the extant literature using OLSDV regression, statistically significant ESTAR and Dual premiums. However, using the better suited fixed effects method, the ESTAR and Dual premiums were no longer statistically significant. The Prof Owner variable remained significant regardless of method.

Sales data findings were consistent with the extant literature.

Further investigating the reasoning behind the different findings of OLSDV and fixed effects, I explored the effect of individual markets. I showed through market by market regression that potential green building premiums may be localized, but no evidence suggesting a national premium was found. In fact, some of the markets even showed negative premiums.

This paper also demonstrated the dramatic effect a couple of markets can have when using OLSDV. By removing just New York City and San Jose from the regression, which did not disproportionately effect the green building N, the ESTAR premiums disappeared with Prof Owner controls. The fact the removal of a mere 2 out of 56 markets alters the statistical significance of the variable of interest raised serious questions as to both the power of the extant findings, and the reliability of OLSDV as an estimation technique for this data set.

Strong evidence for the linkage between professional ownership and rent was presented. The results suggested that ESTAR and Dual buildings were roughly 4.5 times more likely to be Professionally Owned than not. Through logistics regression on the sales data, I demonstrated that professional buyers have an increased appetite for green buildings. Professional buyers were 2 to 3 times more likely to purchase a green buildings, but no correlation was found to sell a green buildings.

Finally, robustness tests in the form of non-parametric and Heckman tests for endogeneity further confirmed the paper's conclusions.

The findings in this paper counter much of the extant literature regarding sustainable real estate premiums. The exploration of alternate estimation techniques such as fixed effects, the inclusion of potentially missing variables like professional ownership, and the detailed exploration of market by market effects represent not only new contributions to the literature, but starting points for continued research.

Size Does Matter presented arguments that real estate portfolios should be examined from an economic perspective in addition to an equal weight. Failure to consider these factors could lead to economically unjustified findings and econometrically biased results. Real Estate investments require capital, as do any financial investments, and returns should be examined from a value weighted perspective.

The paper showed that the assumption of equal weights may lead to biased results when estimating market premiums. At a minimum the paper findings argue that examining both equal and value weight portfolios is a critical step..

The finding in this article also strongly supported the presence of a professional management premium, and the possibility that professional management represents the agent of sustainability premiums. These results showing ownership rental premiums across size categories support and are consistent with the findings in Managing Well by Managing Good.

The results from the empirical tests demonstrated clear patterns in the distribution of ESTAR rental premiums. Premiums were driven by smaller buildings, while the larger buildings provided no evidence of sustainability premiums. Since nearly half of the buildings over 225,000 SF achieved some level of green designation, perhaps the green designation is becoming more of an expectation in that segment. In addition, the findings here of 4% to 5% premiums for only the smallest ESTAR buildings are economically realistic.

Similar to the rental database, the largest building sales regressions showed that ESTAR held no premiums for the largest buildings. The economic impact clearly shows in the sales premiums. An investment choice to purchase a $100 Million dollar buildings represents a drastically different choice than to purchase 10 unique $10 Million dollar buildings. In fact, weighting by price had dramatic effect in most of the size categories. While some sustainability premiums were found, the economic impact of those was less for the smaller size categories.

Only LEED stand-alone buildings seemed to hold cross all size categories.

The quantile regression results confirmed this pattern; they clearly showed variations along the conditional means. Each of the premiums shown by the sustainability categories tailed off at the upper end of their distributions. Not only does the quantile regression support the findings that stratified size and economic attributes effect premium analysis, but they raise questions regarding the overall viability of OLSDV regression as an efficient tool to research a broad swath of buildings. OLSDV assumes some level of consistent variance around the mean, but as conditional distributions vary, the reliability of those estimators was called into question.

This paper provided evidence that potential market premiums, at least specific to green premiums, were size and/or price dependent. It demonstrated clear evidence that value weighting alters regression results in real estate sales portfolios.

A New Paradigm presented a theoretical basis for the use of alternative real estate estimation models to pure hedonic regressions. It showed that national regressions impose supply and demand factors across markets, while the extant literature clearly demonstrated market by market differences.

This article presented one of the first alternative models for real estate value and baseline normal return estimations in the literature. The empirical results demonstrated consistent application of the theoretical model to real life data. The first model was a basic matching model, based on the grid method. The automated algorithm selected 3-10 comparable properties, and estimated an expected rent. The second model, hedonic matching, built upon the first; it used hedonic regression coefficients from the subject market to adjust the expected rent calculations based on the attribute differences of the subject and comparable properties.

The theoretical model presented was an objective, repeatable method using matching with the CoStar database. The core models demonstrated consistent failure to reject the null hypothesis of no difference between expected and observed rent in the 10th and 90th percentile tails of the distribution. Strongest performance was observed in larger markets, with more comparables from which to select.

The null hypothesis of no difference in rent was consistently rejected in the tails of the 500 test distributions. The Hedonic RHAT model, which adjusted the expected rent using the hedonic coefficients as the adjustment parameters effectively estimated expected rent. The Basic RHAT model, which selected comparables and averaged their rent to estimated expected rent, performed with similar efficiency.

Holdback and control model test also supported and confirmed the model's efficacy.

Increased data availability for real estate researchers may represent the beginning of new age in real estate research. No longer confined to private, one-off data sets, researchers can now begin to investigate the best way to research. Alternative research methods may open the door to a host of fresh findings, and new ideas in the field. It is the author's hope that this articles represents merely the start of a new age in empirical real estate research.